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THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION

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Removal of Fractured Root—*Proctor*
Finishing of Process—*Miller*
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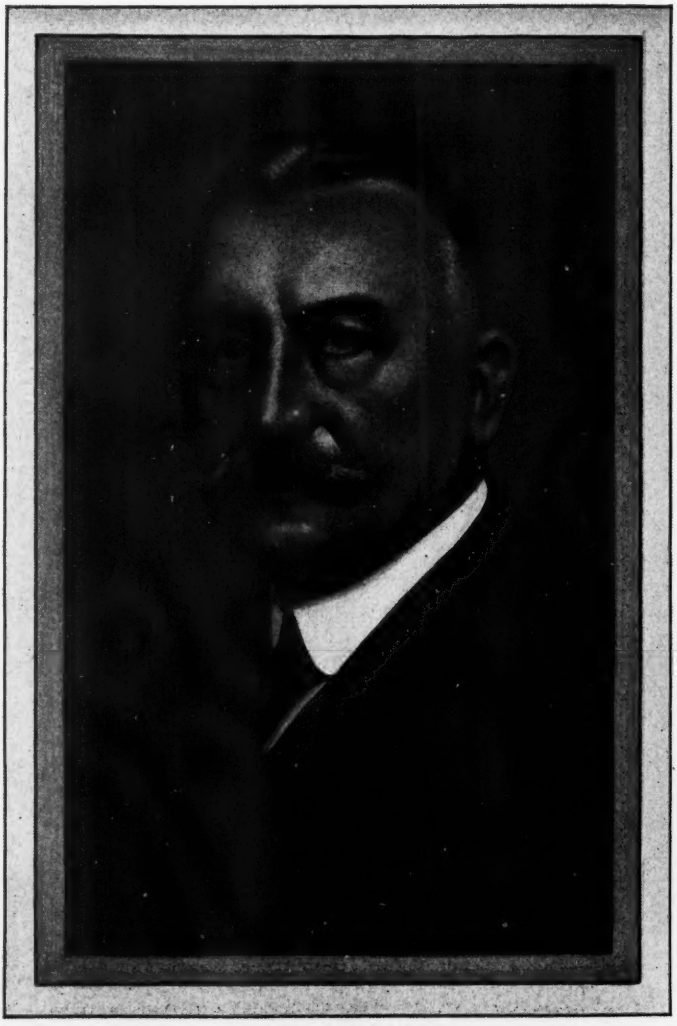

PROF. DR. WILHELM DIECK, Berlin, Germany
Awarded the International Miller Prize at Cologne, August 2, 1928

UNIV. OF MICH.

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Original Communications

PULP PATHOLOGY AND TREATMENT PROBLEMS*

By EDGAR D. COOLIDGE, B.S., D.D.S., F.A.C.D., Chicago, Ill.

IN the last ten years, the question as to what becomes of the remnants of pulp tissue left in the canal after pulp removal has been given much study. Clinical results have often been satisfactory when the canals were inaccessible and the pulp tissue could not be entirely removed. Even the larger canals have doubtless contained a rim of pulp tissue clinging to the surface of the canal. Aside from that, more or less débris from the mechanical procedure of cleaning and enlarging the canal might be found by the microscope in most cases, after the canal has been prepared for filling. In spite of this failure to accomplish mechanical perfection in cleaning canals, abundant evidence is available to prove that a high percentage of satisfactory results have been obtained in root canal treatment and filling.

When a case is presented for treatment, a careful diagnosis of the condition requiring treatment should be made by the application of one's understanding of the change taking place within that pulp and pericemental membrane. A roentgenogram is usually taken to show the condition of the bone in the periapical region. It is very common to find a definite rarefied area around the apex of a tooth containing an inflamed pulp. Just what this pathologic bone process means can be better understood by observing the same or similar tissue under the microscope. The same is true in regard to the diagnosis of changes in the soft tissue which we try to determine by clinical examination. As far as we are able to interpret by the clinical diagnosis what a histopathologic picture might reveal we can institute the proper treatment. The study of the microscopic picture should aid clinical judgment. The

*Read before the Illinois State Dental Society, May 9, 1928.

*From the Research Department (Director, Balint Orban) of the Chicago College of Dental Surgery, Dental Department of Loyola University.

significance of a radiolucent area is not entirely understood; and in diagnosis, mistakes are easily made, and useful teeth are sacrificed which should be saved by careful treatment. A few cases are here presented to illustrate tissue reactions in teeth during disease and after treatment.

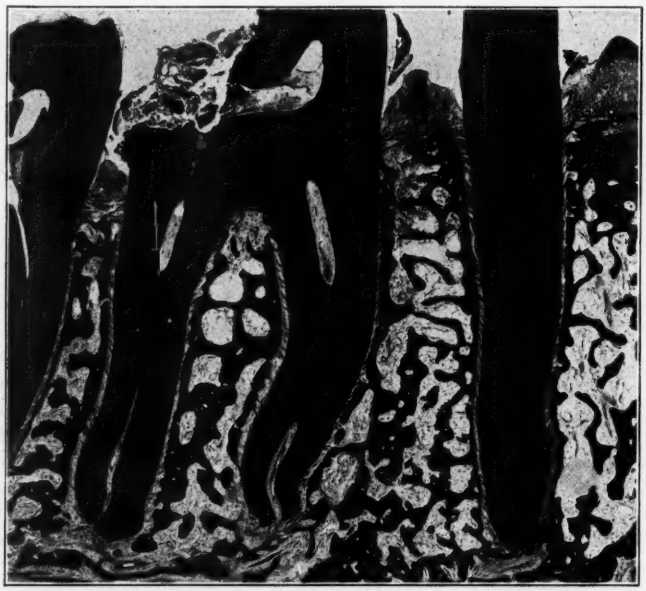

Fig. 1.—Section of human jaw. Lower second bicuspid, first molar and mesial root of second molar. There is a break in the lamina dura at the apex of both roots of the first molar.

Figure 1 shows a portion of the lower left jaw which was removed from a man, aged 25, who died in a hospital with tuberculous pneumonia. The illustration shows the second bicuspid, the first molar and the mesial root of the second molar. A large distal cavity in the first molar exposes the pulp chamber. This tooth contains the diseased pulp that will be described. The picture shows the entire view of the tooth and supporting tissue. The second bicuspid and second molar contain living normal pulps. The oblique cut of this section shows only dentin and not pulp. The pulp can be seen in other sections of the series. In this low magnification, only the gross structure can be studied. The alveolar bone around the second bicuspid is almost a continuous line, interrupted only in a few places by blood vessels connecting the blood vessels of the pericemental membrane with those of the marrow spaces. This continuous bone lamella is the alveolar bone and is termed "lamina dura," the light line around the root seen in the roentgenograms. The alveolar bone of the first molar shows some differences in the apical region from that of the second bicuspid. The alveolar

bone around the apices of this tooth is not an unbroken lamina but pericemental membrane can be seen to connect with the marrow spaces in many places. The periodontal tissue in these places is several times wider than on other parts of the roots. The changes around the apex will be described later, but attention is directed to the fact that this is the condition which will show in a roentgenogram as a rarefied area around the apex. No definite radiolucent area would be seen, but the break in the lamina dura would be evident. The following pictures show different areas in the pulp canals and apical pericemental membrane.

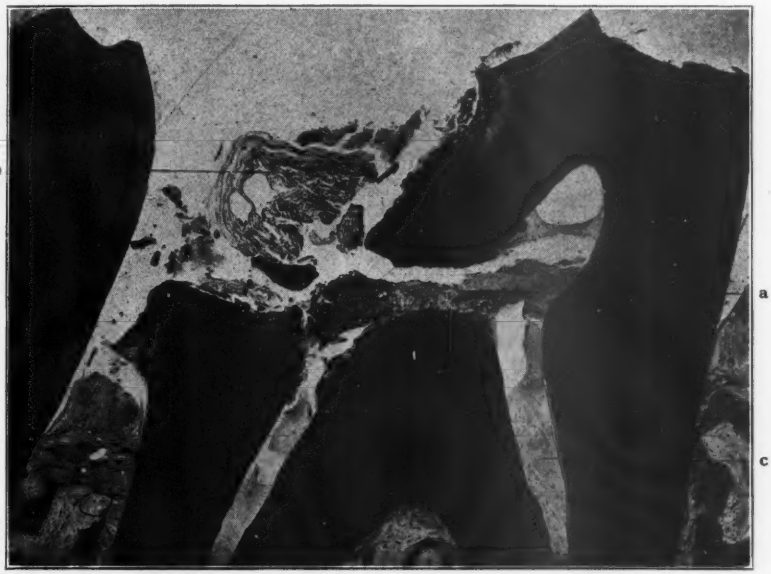

Fig. 2.—Crown portion of the molar shown in Figure 1. *a*, pulp chamber exposed by caries filled with necrotic material; *b*, food remains in the cavity; *c*, mesial pulp canal containing necrotic and inflamed tissue.

Figure 2 shows the exposed pulp in the pulp chamber and the upper portion of the root canals. The pulp chamber is widely exposed and remains of food lie within the cavity. The pulp tissue in the pulp chamber is necrotic and destroyed; also, bacterial plaques and probably calculus line the entrance to the pulp canals. As higher magnification will show, the pulp is not wholly necrotic, only the upper portion, while, lower down, inflammation is present.

Figure 3 illustrates the line of demarcation between the necrotic and the inflamed but living areas. In the necrotic area, the cell nuclei stain very pale or not at all, a sign of disintegration of the cells. In the inflamed area, many wide blood vessels and many round, small and large cells of inflammatory type may be noted. The wall of the pulp canal is

lined by a thin layer of secondary dentin. Odontoblasts in this area are missing. Higher magnifications of different areas of the canal will show the type of inflammation.

Fig. 3.—Higher magnification of portion *c* of Fig. 2. *a*, necrotic tissue; *b*, inflamed tissue. The walls of the pulp canal are lined with secondary dentin. No odontoblasts are present.

Figure 4 shows that most of the inflammatory cells in this area are plasma cells. These cells, which are very common in chronic inflammations, are a sign of defense. Maximow,[1] a recognized authority on inflammation, classifies these cells as a type of "polyblast." He states:

> The polyblasts, the mononuclear exudate cells, are doubtless the most important factors in the inflammatory defense reactions. After the special leucocytes, which appear first, have done their work, the polyblasts, gradually increasing in numbers, display great energy in removing the cause of the inflammatory irritation and in cleansing the tissue of the various débris. They engulf and digest all kinds of useless and obnoxious

1. Maximow, A.: Morphology of the Mesenchymal Reactions, Arch. Path. & Lab. Med., 4:557 (Oct.) 1927.

material accumulated in the tissue—dead cells, micro-organisms and various particulate substances.

He claims that they have a double origin.

They arise, in fact, from local fixed cells and in part from non-granular blood leucocytes. The local cells in question are the resting wandering cells or the histocytes (clasmatocytes) in the common loose tissue and in the serous membranes. . . . As is best seen in vitally stained animals, these cells, under the influence of the inflammatory stimulus, wake up, mobilize, become active and are transformed into large, ameboid, phagocytic elements. The blood cells taking part in the formation of polyblasts are the lymphocytes and monocytes. They migrate out of the blood vessels, together with the special granular leucocytes. While the latter soon degenerate, the additional migration of non-granular cells into the tissue continues for a long period. The non-granular leucocytes undergo rapid hypertrophy in the tissue; after two or three days, these hematogenous polyblasts cannot be distinguished from the polyblasts of histogenous origin. . . . Only a small part of the polyblasts degenerate. Most of them remain in the tissue when inflammation subsides.

As Maximow claims, most of the polyblasts become changed into fibroblasts. The plasma cells are a type of polyblast originating also from lymphocytes but do not change into fibroblasts but degenerate and disappear. The main function of the plasma cells is to digest protein decomposition products.

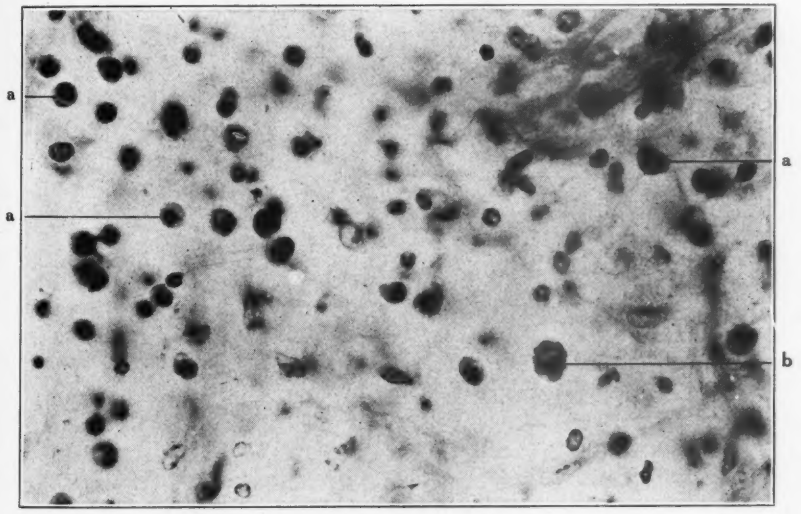

Fig. 4.—High magnification of inflamed pulp. *a*, plasma cells; *b*, plasma cell beginning to degenerate.

In Figure 4, a large cell may be observed which shows a large protoplasm body filled with large granules and a single nucleus. This cell is also a plasma cell, and the granules are an evidence of degeneration of the protoplasm. These granules are called Russell's bodies, and if the cell becomes quite disintegrated, Russell's bodies may be found free in the tissue. A few of these free bodies

can be seen in other parts of the specimen. Figure 5 shows the same type of cells as described in Figure 4, but the remarkable thing is that so many of the cells within a pulp should be filled with chronic inflammation are the productive changes noted farther away from the source of the inflammation.

Figure 6 shows new formation of connective tissue cells and new formation

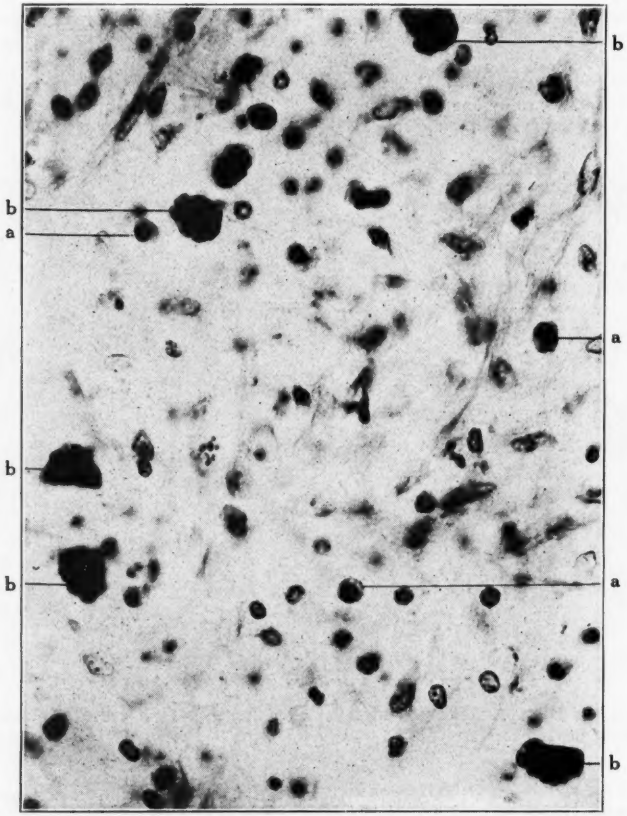

Fig. 5.—High magnification of portion *c* of Fig 3. *a*, plasma cells; *b*, degenerated plasma cells filled with Russell's bodies.

Russell's bodies. Few polymorphonuclear leukocytes are found in the specimen. The absence of leukocytes and the presence of lymphocytes and plasma cells is an indication of the chronic nature of this inflammation. Further signs of this of dentin substance on the wall of the canal. The new dentin is secondary dentin. A discussion of the building and nature of this formation will not be entered into here. It should be noted that the odontoblasts become gradually closed

in within this matrix of secondary dentin. Figure 7 shows this secondary dentin in higher magnification. The fibrous nature of this matrix is evident. It is probably of a collagenous nature as is that of the matrix of primary dentin. As this picture very closely shows, the entering the primary dentin but are absent in this secondary dentin.

Figure 8 shows a portion of the distal root not far below the area of inflammation where living and active odontoblasts may be seen. A layer of uncalcified dentin indicates the last product of these

Fig. 6.—Deposits of secondary dentin (*a*) on the walls of the canal. *b*, enclosure of odontoblasts in secondary dentin; *c*, pulp with wide blood vessels.

building of this matrix is not absolutely dependent on the function of the odontoblasts, as the odontoblasts can be seen already closed in within the matrix, and the building proceeds without them. The Tomes' fibers, the protoplasmic processes of the odontoblasts, can be seen odontoblasts. It is remarkable that, in a case like this, in which the carious process has destroyed the coronal portion of the pulp and the pulp chamber is open to invasion of any type of bacteria, in the midroot living odontoblasts are building dentin. The odontoblasts, as is well

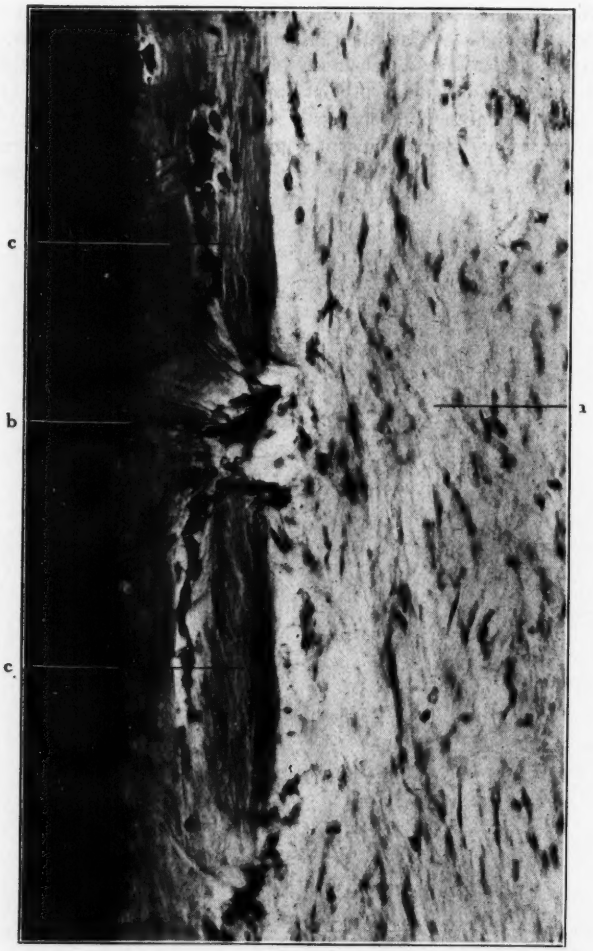

Fig. 7.—Portion *b* of Figure 6 highly magnified. *a*, pulp; *b*, odontoblasts just becoming enclosed by a fibrous matrix of secondary dentin; *c*, secondary dentin under which enclosed odontoblasts can be seen.

known, are highly specialized and very sensitive cells. It seems that, through the defense reaction of inflammation, the bacteria proceed very slowly, and only the toxins have penetrated far toward the apex. However, the presence of the living odontoblasts is unexplainable by us. This becomes more remarkable in the fact that, farther down in the canal, no living odontoblasts can be found.

Figure 9 shows the apical third of the root. In this low magnification, it

is evident that no odontoblasts are present, and the pulp tissue itself does not show the normal structure. In several places, resorption of the canal wall may be seen. A higher magnification in Figure 10 shows that the innermost layer of the dentin, probably a layer of secondary dentin, is resorbed and remains present only in a few places. The type of connective tissue in the root canal is more like scar tissue poor in cells and rich in fibers. The resorption lacuni are very shallow and contain no polynuclear osteoclasts but only mononuclear cells. This may be the sign of low activity in the resorption process. In some places, in connection with the dentin, calcification of pulp fibers can be seen.

Figure 11 shows a wide blood vessel stretched around the curved wall of the root canal. On this side of the pulpal wall, resorption can be seen, and it seems reasonable to conclude that the resorption here was caused by the pressure of the stretched and dilated blood vessel.

Fig. 8.—*a*, odontoblasts; *b*, new uncalcified dentin; *c*, calcified dentin; *d*, pulp.

Figure 12 is a higher magnification of the place of resorption. On the opposite side of the canal, an earlier resorption took place and was repaired by a deposit of bone or cementum-like substance. The same process has taken place lower down, below the area where the capil-

lary lies in contact with the dentin. Few cells of inflammatory type can be seen in this field.

In Figure 13, the changes in the pericemental membrane around the apex can be seen in low magnification. The first noticeable point is that the lamina dura shows lacunar resorption. Some of the lacuni contain mononuclear and polynuclear osteoclasts, but others show none. The principle fibers of the pericemental membrane around the apex are missing and only a more or less soft connective tissue can be seen. The marrow spaces

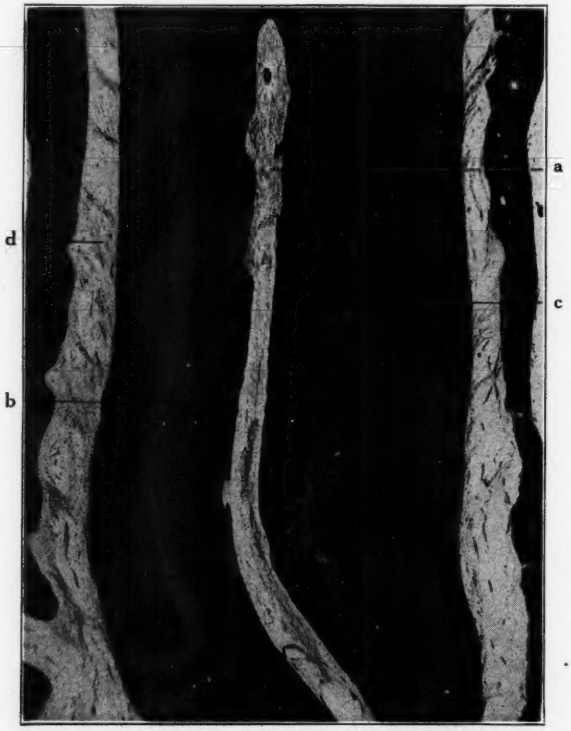

Fig. 9.—Apical third of one root of the molar. *a*, resorption of dentin in the wall of root canal (compare Figure 10); *b*, dentin; *c*, cementum; *d*, pericemental membrane.

which lines the sides of the root in an almost unbroken line becomes broken at the apex and the pericemental membrane is at many places confluent with the narrow spaces. The pericemental membrane border of the bone trabeculi show also a soft fibrous character, a sign of inflammatory reaction. In some places at the apex, small areas of resorption of the cementum may be noted. High magnification, as seen in Figure 14, shows the character of the connective tissue of

the pericemental membrane and adjacent marrow spaces. Numerous wide capillaries interweave the whole field. The connective tissue fibers run without any characteristic direction, contrary to the normal pericemental membrane. Between the fixed connective tissue cells, the fibroblasts, can be seen many small and large round cells of inflammatory type, the same as were seen in the inflamed pulp, only in smaller numbers. They are mostly plasma cells, as seen in Figure 15 in higher magnification. Figure 16 shows a capillary of the same region. The large endothelial cells are the sign of inflammatory reaction. Inside the capillary, as well as outside, lymphocytes can be seen. A mast cell with a fine granulated protoplasm body and small nucleus can also be seen.

Fig. 10.—Higher magnification of Figure 9. *a*, shallow resorption lacuni in the dentin. The innermost layer of dentin (*b*) has been mostly resorbed. *c*, spicule of remaining secondary dentin; *d*, pulp fibers becoming calcified in a resorbed area; *e*, scarlike pulp tissue.

In summing up the findings obtained in the study of this case, we can say that

this tooth contained a partially necrotic and partially chronic inflamed pulp. The signs of the chronic inflammation are the presence of inflammatory cells of the type of lymphocytes and plasma cells and new tissue building. The resorption and repair may be conceived also as a reaction in chronic inflammation. The question arises as to whether the changes around the apex as well as in the apical portion of the root canal are due to the direct influence of present bacteria or to the reaction to toxins of the bacteria lying near the outer surface of the pulp. The slow progress of this chronic inflammation and the presence of the large number of plasma cells, together with the functioning odontoblasts in one area and dentin building in another, would lead to the conclusion that only the toxins of bacteria had entered the pulp and that pathogenic bacteria had been successfully checked by the defensive influence of the inflammatory cells. The changes around the apex show that the inflammatory products have been carried along the blood and lymph channels into the periapical tissue. As a reaction to these irri-

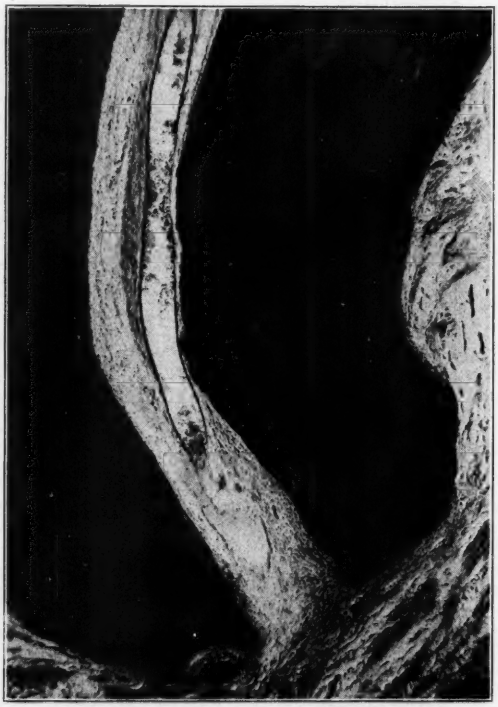

Fig. 11.—Apical region of one root. The enlarged blood vessel in the canal stretches around the curve of the canal. Resorption may be seen beneath the blood vessel and also at the apex.

tants, we find the loss of principal fibers around the apex. Resorption of the bone made the pericemental space wider, and inflammatory defensive cells have appeared in the tissue. It is possible that, removal of the infected part of the pulp and sterilization of the canal, the reactive changes in the pericemental membrane and adjacent tissue would restore these tissues to a normal condition; that

Fig. 12.—Higher magnification of Figure 11. *a*, capillary; *b*, resorption of dentin beneath capillary; *c*, repair of previously resorbed areas by bonelike substance; *d*, scarlike pulp tissue.

in the tissue changes around the apex, circulatory changes, such as destruction of blood vessels in the pulp, and inflammatory hyperemia may also play a part. It is reasonable to assume that, with the is, new deposition of cementum on the surface of the root, building of the principal fibers of the pericemental membrane and, consequently, new building of alveolar bone.

One of the remarkable things in this specimen is the fact that hard substance is being built in this pulp by three different kinds of tissue, all perhaps functioning at the same time. The odontoblasts can be seen building normal dentin in one place. In another place, secondary dentin is being formed by collagenous fibers of the pulp, and nearer to the apex, bonelike substance fills out resorbed areas in the dentin.

Fig. 13.—Apices of both roots of the molar. There is a break in the lamina dura at the apex of each root. The pericemental membrane communicates at many places with the marrow spaces. The principal fibers of the pericemental membrane are lost at the apex.

It would lead too far to enter fully into the problems of treatment, but the study of this and other cases which will follow, together with a study of the literature of the last few years, points to one conclusion. Many entirely different methods are used throughout the world for the treatment and filling of root canals. Every one who has evolved a technic which has been highly successful in his operations feels confident that his method is the best. We could mention many investigators and operators of European countries and of our own who would doubtless make such a statement. The fact that so many men operating by as many different methods all show successful results would suggest that it is not of primary importance how the canal is treated, what drugs are used or how, or with what material the canal is filled, but all agree that the infection must be controlled, the operation must be absolutely aseptic and the remedies used in treating and filling should not injure the periapical tissue. In a survey of the literature, we find that many investigators

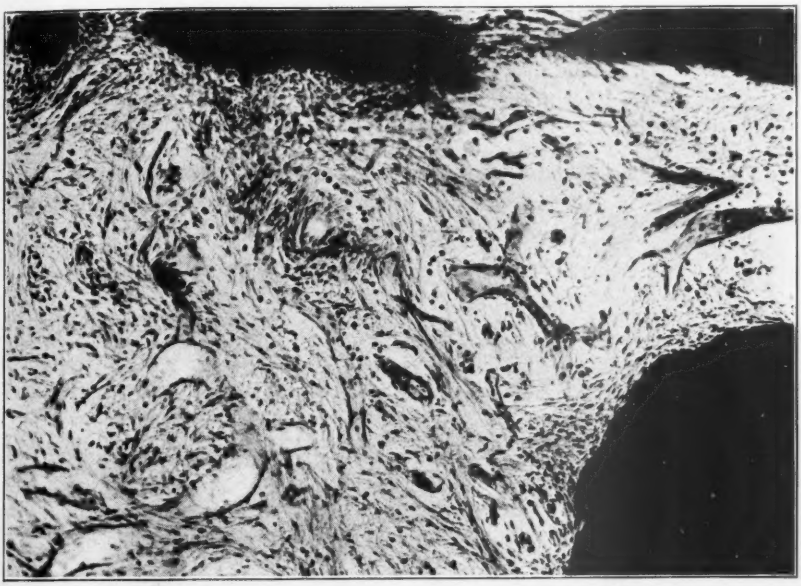

Fig. 14.—Higher magnification of the pericemental membrane near the apex. There are numerous wide capillaries. Connective tissue fibers cross each other in every direction. Many plasma cells may be noted in the tissue.

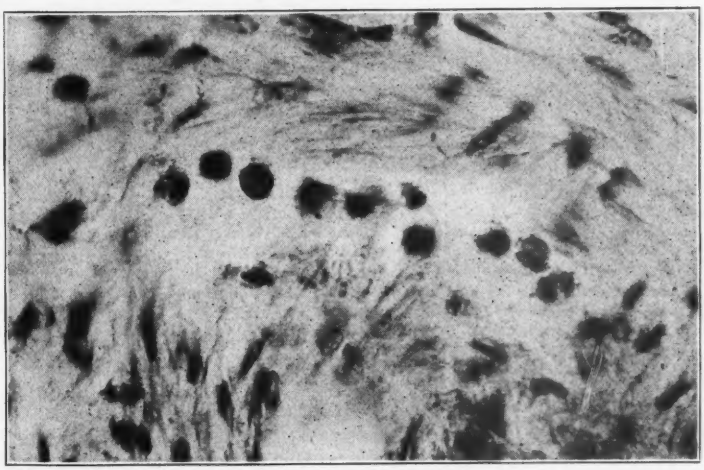

Fig. 15.—High magnification showing plasma cells in the pericemental membrane.

show as the ideal condition a deposit of bone or cementum-like substance in the root apex, which, in time, may obliterate the canal. That "All roads lead to Rome" is an old saying, and it seems that, in the root canal problem, those roads leading to success must be built upon a thoroughly aseptic procedure regardless of the method used.

The most extensive investigations on this subject have been conducted by a group of scientists who are known as the "Switzerland Group." The leaders are men of such renown as A. Gysi, W. Hess and O. Müller. The investigations started about the time that Hess[2] developed his comprehensive work on the anatomy of root canals. In 1919, Sieg-

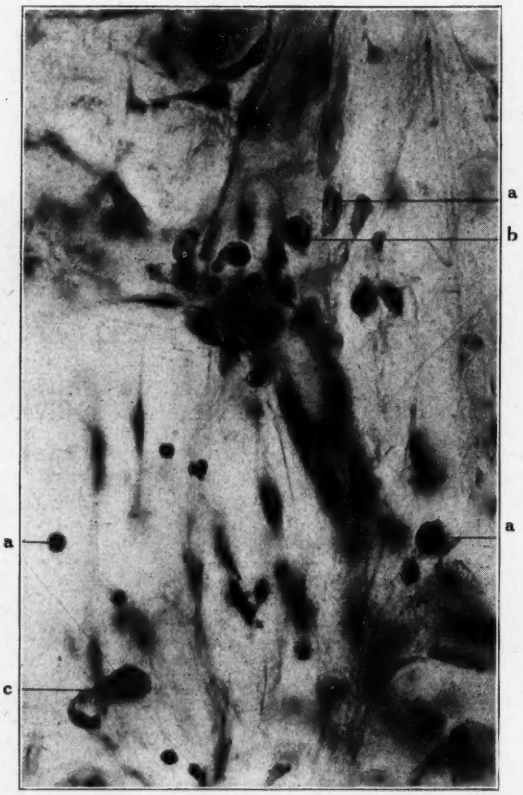

Fig. 16.—High magnification of a capillary in the pericemental membrane. *a*, lymphocytes in the pericemental membrane and in the blood vessel; *b*, thickened endothelial cell in the wall of the capillary; *c*, mast cell.

2. Hess, W.: Anatomy of the Root Canals of Human Teeth, Schweiz. Vierteljahrsschr. f. Zahnheilk., 1917; translated into English, J. A. D. A., 8:704 (Sept.), 790 (Oct.) 1921.

fried Meyer,[3] of the same group, reported experiments on rabbits, showing deposits of bone or cementum in the pulp canal after devitalizing the pulp. After this publication, many investigators directed their attention to the same problem. Müller,[4] in 1920, showed deposits of bone in the pulp canals of human teeth almost closing the canals, and he believes that, under proper conditions, the pulp canals will become entirely closed with bone. Müller made his investigations on teeth with pulp amputation and later extended his statements to include extirpation as well. As the main principles favoring bone deposits

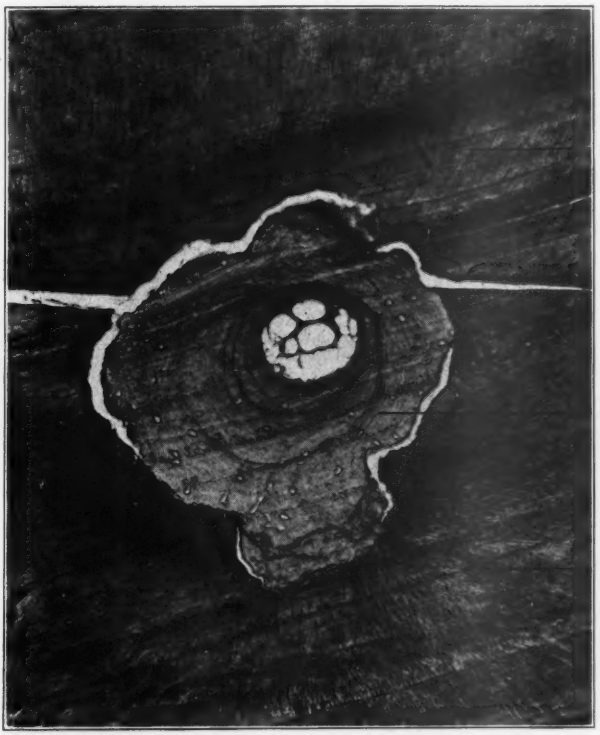

Fig. 17.—Photomicrograph of the case shown in Figure 19. *a*, dentin; *b*, bone-like substance deposited in the root canal after slight resorption had taken place.

3. Meyer, Siegfried: Pulp Amputation, Pathologic and Bacteriologic Studies, Schweiz. Vierteljahrsschr. f. Zahnheilk., 1919.

4. Müller, O.: Contribution to the Histology of Amputated Pulps, Schweiz. Vierteljahrsschr. f. Zahnheilk., 1920, pp. 38 and 273; Pulp Devitalizing and Root Canal Filling, Ztschr. f. Stomatol., 23:177, 1925; Contribution to the Problem of Root Canal Filling After Devitalization of the Pulp, Schweiz. Monatsschr. f. Zahnheilk., 36:765 (Dec.) 1926; New Investigations on the Extirpation of the Pulp and Root Canal Filling, Ztschr. f. Stomatol., 25:970 (Oct.) 1927.

Fig. 18. — Infection in the root canal with, consequently, no bone deposit. *a*, guttapercha root canal filling partly lost while sectioning; *b*, leukocytes (pus); *c*, resorption at apex.

within the pulp canals based upon his experimental work, he requires that the work be aseptic, that the tissue left after pulp removal both within the canal and beyond the foramen shall not be injured and that the canal filling shall be in contact with the pulp stump.

5. Davis, W. C.: Histopathology of the Cementum as Related to Pulp Canal Surgery; Dent. Cosmos, 52:766 (June) 1920.

In this country, attention was directed by Davis[5] in 1920 and Grove[6] in 1921 to the vital reaction in the periapical tissue after canal filling. Grove stated that "if we will only allow nature a fair

6. Grove, C. J.: Nature's Method of Making Perfect Root Canal Fillings Following Pulp Removal, with a Brief Consideration of the Development of Secondary Cementum, Dent. Cosmos, 53:968 (Oct.) 1921.

chance to take care of the root ends of teeth where pulps are removed, the percentage of infections resulting from such teeth will be very small." In 1921, Davis[7] made an extensive report on the

Fig. 19.—First case described in the text (tooth marked with cross).

Fig. 20.—Second case described in text. The canal was filled in 1910 (incomplete filling). The root is marked with an arrow.

changes of tissue structure in the pulp following partial pulp removal, showing many illustrations. His conclusion was that these changes could be expected to take place only where no infection is present and where the pulp remnant is vital and uninjured by drugs. In 1922, Hatton[8] reported on resorption and regeneration of the canal walls in the apical region following canal filling. His conclusion was that aseptic work and a nonirritating technic are necessary requirements for bone deposits to follow pulp removal and canal filling.

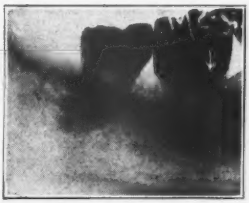

Fig. 21.—Tooth referred to in Figure 20, refilled in 1922.

Fig. 22.—Tooth shown in Figures 20 and 21, at the time of extraction in 1927.

In 1924, Skillen[9] reported studies of tissue changes in root canals. He emphasized the importance of retaining the vitality of the pulp remnant and causing as little trauma as possible in operating. In 1923, K. Lutz,[10] of Zurich, reported many cases following treatment from one to six years, in which deposits of bone are shown in the pulp canals. The same conclusion is drawn as by Müller.

7. Davis, W. C.: Structural Changes Within the Pulp Canals of Teeth Following Partial Pulp Removal, Dent. Summary, 51: 482-492 (June), 563-570 (July), 653-658 (Aug.), 787-790 (Sept.) 1921.

8. Hatton, E. H.: Possibility of Apical Regeneration After Root Canal Filling from the Histopathologic Point of View, J. N. D. A., 9:192 (March) 1922.

9. Skillen, W. G.: Hard Tissue Changes Noted Within the Canals of Treated Teeth and Their Possible Significance, J. A. D. A., 11:350 (April) 1924; Status of the Treated Tooth, J. A. D. A., 13:291 (March) 1926.

10. Lutz, K.: Histologic and Bacteriologic Investigations Regarding the Effect of Triopaste in Pulp Amputation, Schweiz. Vierteljahrsschr. f. Zahnheilk., No. 3, p. 81, 1923.

Rywkind[11] and other European operators report similar results. In 1927, Blayney[12] reported investigations along similar lines. He also points out the necessity of an aseptic nonirritating technic.

A few cases selected from my practice illustrate the important part Nature plays in the success of some of our efforts to remove pulps and fill root canals successfully.

stance nearly obliterating the canal under the end of the root canal filling, as shown in Figure 17. We can assume that no bonelike substance could be deposited in the canal in the presence of virulent infection; hence, the operation must have been of an aseptic nature. Figure 18 shows a case in which the root canal filling nearly reached the foramen, but owing to the presence of uncured inflammation, no bonelike substance could be

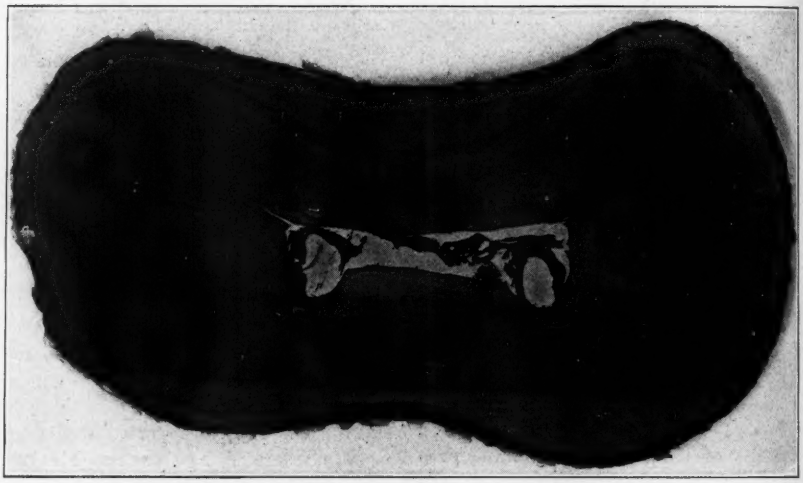

Fig. 23.—Photomicrograph of case shown in Figures 20, 21 and 22; cross-section of root in coronal third. The guttapercha in the canal was partly lost in sectioning.

Occasionally, a tooth containing an incomplete root canal filling of long standing, as shown in Figure 19, a roentgenogram for which no history is available, after sectioning will show a deposit of cementum or bonelike subbuilt. The large mass of inflammatory cells and the consequent absence of connective tissue cells made rebuilding impossible, and the result was unsatisfactory.

The following case is one of pathologic as well as clinical interest. The pulp of a lower left first molar of a woman, now 45 years of age, was devitalized with arsenic and the canals filled with guttapercha in 1910. The tooth required re-

11. Rywkind, A.: Cementum Building in the Root Canal and the Pulp Chamber, Ztschr. f. Stomatol. 2 (Feb.) 1926.

12. Blayney, J. R.: The Biologic Aspect of Root Canal Therapy. Items of Interest, 49: 681 (Sept.) 1927.

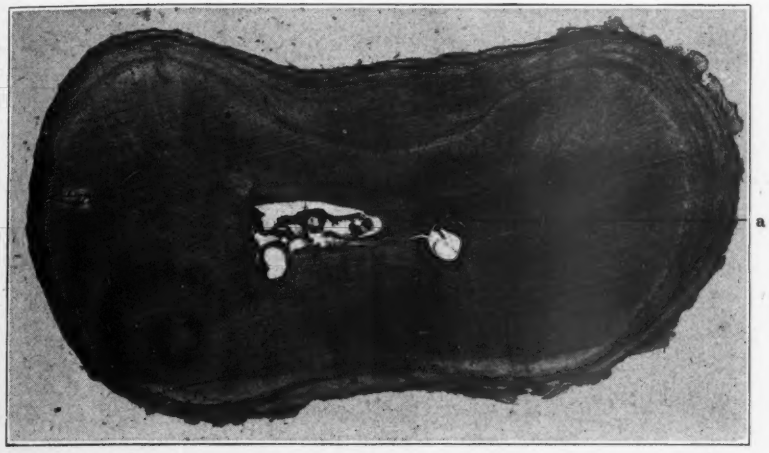

Fig. 24.—Case shown in Figure 23 in midroot. There is some bonelike substance in the original canal (*a*).

Fig. 25.—Case shown in Figure 24, nearer the apex. Two canals were made with the broach because the original canal was filled with bonelike substance (*a*).

construction in 1922, and a roentgenogram was taken at that time (Fig. 20).

The tissue of the periapical region showed no noticeable disturbance, but it seemed advisable to replace the imperfect root canal filling, a further attempt being made to fill it completely. After removing the old canal filling, it was impossible to open the canals much further than they had been filled previously.

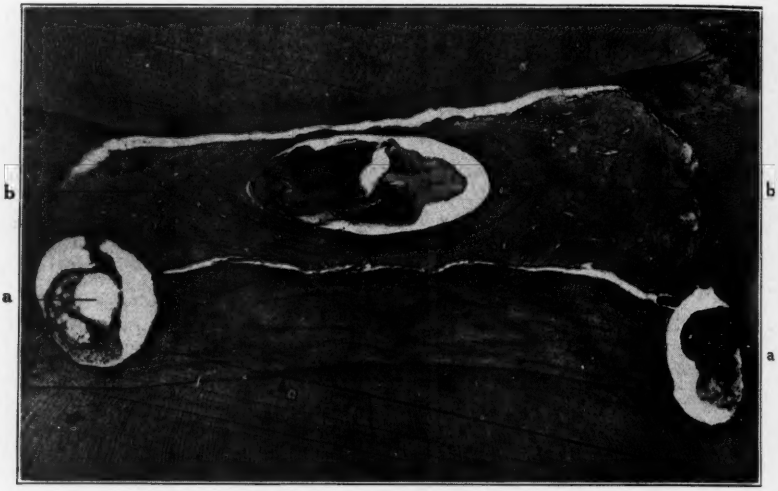

Fig. 26.—Higher magnification of the root canal in Figure 25. *a*, artificial canals filled with guttapercha which has been partly lost; *b*, bonelike substance filling the original canal.

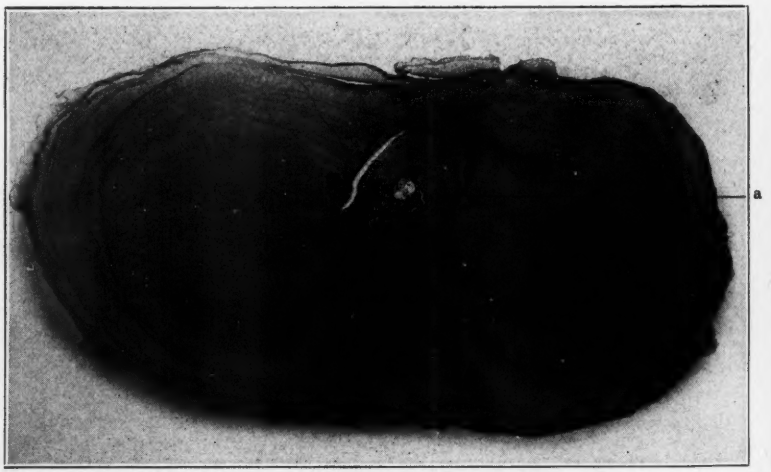

Fig. 27.—Case shown in Figure 26, near the apex. The original canals have merged into one which is almost obliterated by bonelike deposit (*a*).

Fig. 28.—Molar tooth, showing incomplete canal filling. The root is indicated by an arrow.

An attempt was made with broaches and reamers, with the aid of sulphuric acid, after which they were again filled with guttapercha and a roentgenogram was taken (Fig. 21). It shows the new canal filling to extend only slightly further toward the apex than the first one. A roentgenogram was taken in 1927 (Fig. 22) which shows no disturbance around the apex. The tooth was extracted be-

Fig. 29.—Section of root marked in Figure 28. *a*, guttapercha; *b*, bonelike substance filling the root canal beyond the guttapercha; *c*, dentin.

cause of deep pyorrhea pockets and discomfort to the patient.

Histologic examination of the same tooth shows interesting features. The following photographs are taken from cross-sections of the mesial root in different levels. Figure 23 is not far below the floor of the pulp chamber. The two root canals are connected with each other by a narrow space, which can be seen partially filled. This mass is guttapercha, a part of which was lost in sectioning. Figure 24, a section nearer the apex, shows that a part of the narrow space connecting the two canals is filled with a cementum or bonelike substance separating the two canals. The two canals lie out of line with the original canal. Nearer the apex (Fig. 25), the whole space, which earlier formed the

Fig. 30.—Higher magnification from the border line between the guttapercha and the bonelike substance filling the canal. *a*, guttapercha; *b*, resorption at the side of the guttapercha; *c*, bonelike substance in the root canal; *d*, canal in the center of the bonelike deposit filled with atrophic connective tissue; *e*, dentin; *f*, slight resorption of the dentin before bone deposition took place.

root canal, is filled with this bonelike substance, with the exception of a very small area in the center. The two round spaces at each extremity are the artificial openings made by forcing the broaches through the solid tooth substance. Figure 26, a higher magnification of the former photograph, shows the bonelike substance filling the canal. In the center are the remains of an atrophic connective tissue and a small piece of bonelike substance. The artificial canals at the two extremities of the original canal are filled with guttapercha, which shows some distortion probably due to sectioning. In comparing Figure 26 with Figure 17, a difference can be seen in that absorption took place in the case of Figure 17, preceding the deposition of the bonelike substance which is not seen in the case of Figure 26. This difference should be noted, but no explanation of its significance can be given at this time. Figure 27 is the apical region of the same root. The original wide, narrow canal became more nearly round and is filled in almost entirely with bonelike substance.

The last case (Fig. 28) was that of a woman, aged 46, whose tooth was extracted because of an imperfect root canal filling and loss of alveolar support, although the periapical tissue appeared normal. Had it been possible to see a histologic picture of this tooth before extraction, the tooth would not have been lost. Figure 29 shows a section through the mesial root. The guttapercha filling ends about 3 mm. from the apex. From the end of the guttapercha to the apex, the whole canal is almost solid with bonelike substance. Following the entire series of sections, we find a very thin canal filled with atrophic connective tissue extending to the foramen. The lamellated structure of this bone shows a periodic deposition, and it is possible that, by longer retention of the tooth in the mouth, the entire canal might have been obliterated. The higher magnification (Fig. 30) shows the region at the end of the guttapercha filling and the beginning of the bone filling. Slight resorption of dentin can be seen along the sides of the original canal and around the end of the guttapercha point. Bone corpuscles and bone lamellae are to be seen here, and this bone resembles bone found in other places.

From the findings reported herein, and by similar findings of other investigators, it is evident that the first requirement in root canal treatment must be an aseptic technic. We have seen, in a few cases, what Nature can do under favorable circumstances, and it is reasonable to assume that she will do the same in a large percentage of cases if we can give her a chance. However, we must not unload our burden on Nature but must do our best to assist and not to hinder her in her vital functions. A comparison of roentgenograms and histologic sections shows that it is not necessary to extract all teeth showing periapical disturbances nor to sacrifice all teeth with imperfectly filled root canals. A simple case of pulp inflammation may cause apical bone resorption without an infection of the periapical tissue. It is also evident that on removal of the pulp and checking of the infection, repair of the apical tissue should follow. This report must not be taken as encouraging partial pulp removal nor justifying careless attempts to fill root canals. It may, perhaps, encourage the careful and painstaking operator who hesitates to save pulpless teeth because of the difficulties and uncertainties attending or following the operation.

REMOVAL OF FRACTURED ROOT ENDS FROM THE MANDIBLE*

By CHARLES M. PROCTOR, D.M.D., Boston, Mass.

THE essential factor in the procedure for the removal of fractured root ends from the mandible is operative space. This may be brought about by making an avenue of entrance to the area by one of three methods: through the root socket, by enlargement with fissure burs; by removal of the buccal plate of the socket, and by lateral entrance through the buccal plate of the mandible.

The first two methods are applicable to cases of recent fracture in which we have a condition of exostosis or curvature of the root. The third is applicable where a root has remained *in situ* over a given period of time and has become encapsulated and completely surrounded by regenerated osseous tissue.

Delicacy of procedure prevents excessive traumatism of the investing tissue; for instance, in case of recently acquired fractured root ends. Many times the root may be dislodged without the removal of any osseous tissue by using a number eight Black hatchet excavator. This instrument acts as a wedge when forced into the area between the root and the socket, the force necessary for insertion of the instrument dislodging the fragment; on the theory that the fragment is in itself a wedge and that two wedges cannot occupy a given space at the same time.

If there is exostosis, it is necessary to produce space for the entrance of the wedge by reaming the socket about the fragment with a fissure bur.

In cases of extreme curvature, parallel incision may be made in the mucoperiosteal tissue anterior to the socket and the tissue flapped 3 or 4 mm. posterior to the socket; the buccal plate of the socket removed, and the area exposed by burs or chisels. After removal, the flap is sutured to place by two horizontal sutures, with an occasional lateral suture, as the case might indicate. The reason for making the incision anterior to the socket is to prevent marked depression of the tissue into the socket as happens when an incision is made at the socket itself and the edges become inverted to the socket during the process of healing, this causing a deformity of the tissue which complicates the adaptation of artificial teeth to the gum tissues.

The technic for entrance by the third method consists in making a horizontal incision of the mucoperiosteal tissue two-thirds the distance between the gingival and the fold of the cheek, retraction being employed that an entrance through the outer plate may be made by bur or chisel. With the exposure of the root, removal is readily made by Black's hatchet excavator No. 8 or a small exolever.

*The papers of Drs. Proctor, Miller and Bear were presented as a symposium.

*Read before the American Society of Oral Surgeons and Exodontists, Detroit, Mich., Oct. 22, 1927.

The best instrumentation is assured by the use of the smallest possible instruments.

Forceps and large exolevers are contraindicated; for, by their use, traumatization is bound to ensue, with excessive postoperative pain and retardation of healing.

Postoperative treatment is simple. Irrigation of the socket with physiologic solution of sodium chlorid or a 1 per cent surgical solution of chlorinated soda (Dakin's), followed by stimulation of a good blood clot, is generally all that is required. I seldom, if ever, attempt to establish drainage. If for any reason I feel that it may be necessary, I suture a small piece of rubber dam for retention and remove in forty-eight hours. A mouth wash of 1 per cent surgical solution of chlorinated soda is prescribed *ad libitum*.

These wounds generally heal by primary intention and need be watched only for a few days. For postoperative pain, I administer amidopyrin (pyramidon), 5 grains, hourly for four or five hours, if necessary. Acetyl salicylic acid (aspirin), 5 grains every hour until the patient is relieved, or until five doses have been taken, may also be prescribed.

INSTRUMENTARIUM

The instrumentarium needed consists of: Black's hatchet excavator No. 8; small exolevers, pliers, mirrors, retractors (cheek and tissue), a needle holder, a black silk suture, sponges, fissure burs, roentgenograms for confirmation of the diagnosis, and a local anesthetic.

SUMMARY

The roentgen ray should be used for confirmation of the diagnosis. In addition, the use of small instruments and the assurance of operative space, with delicacy of manipulation and patience, are the essentials for the successful removal of root tips from the mandible.

FINISHING OF THE PROCESS*

By HOWARD C. MILLER, D. D. S., Chicago

IT is my object, in presenting this paper as part of the symposium, to cover the important step of "Finishing of the Process" and to emphasize the fact that the duty of the operator does not end with the mere removal of the tooth and root fragments.

A great many believe that the consideration of this subject is old and that nothing new can be added to what has already been presented many times. This may be true; but while the fundamentals are well established, the opinions and procedures of different operators are so divergent that many have been at a loss to know just how to proceed.

It is impossible to lay down iron clad rules that must be followed in every case, but the importance of a definite and thorough technic which can be followed

*Read before the American Society of Oral Surgeons and Exodontists, Detroit, Mich., Oct. 22, 1927.

as a basis of operation should be emphasized.

Presentations that stimulate thought and effort toward the standardization of a conservative technic will do a great deal toward helping us all to come somewhere near an agreement and to give the patient the best possible result. All of which may be brought about by a more careful study and check of the final results of operative cases and a closer cooperation with the one making the restoration.

The responsibilities assumed in accepting a case for the removal of teeth are greater than they have been believed to be in the past. As it is only within the past few years that any particular thought has been given to the possible relationship between infected teeth and subsequent remote disease of the body, the service formerly consisted simply in relieving the patient as best we knew how.

The first and important duty of the operator is the removal of the teeth, with the least amount of trauma necessary, the removal of all root tips and the complete eradication of all pathologic areas resulting from the presence of the offending teeth. The second is that since he is dealing with the foundation of the dentures which the patient is to wear for many years to come, he must keep in mind the future restoration, and work along definite lines, in order that this foundation may be the best possible considering the pathologic condition present.

It is the belief of many that the advocates of this procedure require the sacrifice of a large amount of bone structure whether it be in the preparation following a single extraction or in a complete case. This is far from true, nor is it in keeping with the final results of a more conservative procedure. Many times, all that is necessary after extraction is the use of small rongeur forceps and bone files to bite and smooth the rough sharp edges of the process which remains after a simple extraction. In many cases, this may be done, where one, two or three teeth have been removed, by retracting the mucoperiosteum sufficiently to allow the smoothing and removal of rough jagged bone, making it unnecessary to reflect a large buccal flap in order to gain access.

In single or multiple extractions in which the operator is to deal with large pathologic areas, broken root tips or a dense bony process, it becomes necessary to make a mucoperiosteal flap, either by an anterior incision or by a double incision, whereby access may be gained by the removal of sufficient process to allow complete elimination of broken root tips and pathologic areas, and to prevent fracture of the heavy process in a difficult extraction. The amount of process that it is necessary to remove in these cases is governed by conditions presented in each individual case, depending on the density of the buccal plate and the size of the area to be removed. The lingual crest in lower cases is trimmed to 2 or 3 mm. below the edge of the lingual gum tissue. In upper cases, the sharp jagged edge of bone on the lingual crest is all that is smoothed unless the reduction of an abnormality is necessary. The tooth socket is then examined for pathologic areas, small particles of bone or tooth fragments, the process smoothed and the flap sutured back into position, the buccal tissues being replaced first with sufficient suturing across from buccal to lingual aspect to retain normal position and contour.

It has become a fact well established by recognized leaders in the prosthetic field that, in the removal of all teeth, an

operative technic should be employed which will facilitate the early insertion of dentures upon a base free from rough, jagged edges of bone that are left for Nature to smooth after a simple extraction.

The desire for this result is to be found in the dental literature of many years ago, when reports show the use of extracting forceps to bite off the sharp projections. But no doubt the first operation following the fundamental principles of bone surgery to be reported in its entirety was by W. L. Shearer, who reported a case in 1905. In the past few years, the demand by the prosthodontists and, in many cases, the patients themselves, for this service, has been constantly increasing, because of the final results following a conservative operative procedure.

The method of obtaining future denture references such as preliminary photographs, the record of the dimensions of the face, the length and alinement of the natural teeth and the preparation and articulation of casts, such as was advocated by J. W. Crawford before this society two years ago, is ideal, and always demands close cooperation between the two specialties.

The operative procedure necessary in a given case is governed by (1) the amount of pathologic destruction present, which is revealed by a complete roentgen-ray examination, not only of the remaining teeth but of all edentulous areas as well; (2) the future esthetics of the case, as to whether or not the reduction of the anterior portion will be necessary for the proper setting of the artificial teeth and restoration of the mouth and facial contour; (3) the physical aspects, such as large bony protuberances, excessively heavy alveolar crests or large bulky tuberosities, and (4) the ridge relation, or the relation of the upper and lower ridges to each other, which, in many cases that are abnormal, may be corrected by proper mouth preparation and may greatly assist the one building the restorations.

After all of these factors have been taken into consideration, the mucoperiosteum is incised about the necks of all the teeth. The mucoperiosteum is then reflected back sufficiently to prevent injury while the process is prepared. In cases in which a difficult extraction is anticipated, owing to a heavy process, excementosed or curved roots, the removal of a portion of the buccal and labial plates over the tooth roots is indicated. This facilitates the removal of the teeth and prevents the fracture of large particles of the buccal or labial plates by the pressure necessary to remove the teeth. When the destruction of bone has been excessive following the absorption from an old case of pyorrhea, the removal of the teeth, pathologic areas and the smoothing of the process is all that is necessary.

After the teeth have been removed, the process in the anterior portion should be trimmed from a point just above the high lip line, arching it over to the lingual. This will prevent development of many of the high thin ridges resulting from an attempt to reproduce the so-called V or U type ridge, which have been so severely criticized. This is one of the steps advocated by Dr. Crawford. The amount of process that should be removed depends on the amount of protrusion present, with full consideration for future esthetics.

In the posterior portion, only the rough sharp edges and bony protuberances are removed by the use of rongeur forceps, chisels and files, the contour of the posterior ridge to the anterior por-

tion being maintained; after which each socket is examined for pathologic areas, small particles of bone or tooth fragments, all of which are carefully removed.

The soft tissues are then examined for small bone particles, unhealthy gum septums and attached granulomas, all of which should be eliminated. After this, the tissues are sutured back into position either by continuous or interrupted sutures, this depending on the choice of the operator. Care is taken that all small vessels bleeding excessively from the bone or soft tissues are stopped before closing.

It so happened that the specimen used in presenting this series had considerable protrusion of the upper arch, so that a restoration following a simple extraction in this type of case would always show an excessive amount of gum restoration and teeth.

The value of the reduction of the anterior portion by arching from a point just above the high lip line lingually may be seen in the casts of a practical case before extraction, following simple extraction and after the process had been prepared.

The value of the reduction of sharp bony projections and rough edges is seen in the next case, which shows the casts of a maxilla presented after simple extraction four weeks prior to the making of the first cast. The second cast shows the same area immediately after the smoothing of the process.

Much has been written for and against the practical value of "Finishing the Process," some basing their criticisms on the ruthless destruction of bone structure, which no doubt has been justifiable in many cases; others, on histologic theories, which most certainly are soundly based if all cases were ideal; others, on the theory that the practical value to the patient is nil, and the financial remuneration to the operator is the only reason for its being employed; and there are many other severe criticisms.

Granting that many criticisms are soundly based, the fact remains that the results of a conservative operative procedure in mouth preparation are overcoming much of the adverse criticism, and requests for this operation by men recognized as authorities in the restorative field seem to be overshadowing the severe criticisms which have been so prevalent.

So by a more careful study of the operative results, both by the roentgen ray and by direct examination, and a closer cooperation with the men making the restoration, much can be accomplished toward standardizing the technic, in order that we may all work in harmony toward a better result and increased benefit to our patients; which is our common objective.

55 East Washirgton Streei.

POSTOPERATIVE TREATMENT*

By HARRY BEAR, D.D.S., Richmond, Va.

IN every surgical procedure, there are definite principles which should be observed. The nature and exigencies of the field under consideration, the maxillae and mandible, influence the application of these principles. The mouth cannot be considered as a separate organ capable of being independently treated: it is an integral part of the human mechanism, and it should be treated with consistent regard of its relationship to the entire physiologic system.

One of the first steps in the treatment of disease is to remove the cause which has produced it. The laity erroneously assume that when a tooth is the cause of local or systemic disease, its removal effects a sudden cure; but we know that the removal of the primary cause of a given disease will not necessarily and immediately cause the subsidence of the disease itself. Any surgical interference, however slight, produces a change in the normalcy of the tissues involved.

An operation should be as exacting and complete as the circumstances in each case warrant, so that the necessity for postoperative care may be diminished. The peculiar susceptibility of each patient is a factor of much importance. What may seem to be simple operative interference may produce exacerbated local and general disturbances in one patient; while, in another individual, an operation of major importance may not produce any of the contemplated postoperative sequelae.

After the roots have been removed and the immediate needs of the wound taken care of, the less local disturbance or interference from this point on, the better the results obtained. Much more harm may be done by overtreatment than by undertreatment in the average uncomplicated case.

Postoperative care may be divided into two main divisions: local and general. Local postoperative treatment of mouth wounds should consist of simple nontraumatizing procedures. Advise the patient not to wash or rinse the mouth for at least the first twelve hours. This may be more indelibly impressed immediately after the operation has been completed by not permitting the patient to wash his mouth while in the office. Explain to him that the less the wound is disturbed by too vigorous washing, which often causes the loss of the blood clot, the less bleeding there will be, and therefore the quicker and better the recovery. It is to be observed in this connection that in those patients with a diminished flow of saliva, the wounds heal more readily; while it seems that in cases of aptyalism, the results are even more favorable. When excessive saliva apparently interferes with healing, atropin may be advisedly used to advantage. As a rule, the external application of ice compresses is ordered not only for the

*Read before the American Society of Oral Surgeons and Exodontists, Detroit, Mich., Oct. 22, 1927.

relief of pain but also because the cold tends to lessen edema and allays the inflammation, thereby reducing the heat necessary for the proliferation of bacteria. There should be no further local attention to the wound itself after the operation has been completed, unless this is warranted by conditions which arise and require it.

Under general care, patients should be advised to rest the parts operated on as far as it is practicable, while rest of the patient is likewise conducive to hastening recovery. Laxatives may be prescribed in order to facilitate proper elimination. A light diet, with more than the normal amount of fluid intake, is advised. For the relief of pain, sedatives are prescribed. Milder remedies are, of course, first used. If these do not suffice, hypnotics may be necessary. There are many drugs available, and the operator should use those which seem to serve his purposes best.

Regardless of the simplicity or gravity of the operation, the patient should be seen on the first, second or third day, this depending on the nature of the case; if not for treatment, at least for observation. If the wound looks satisfactory, nothing is done to disturb the healing process. Gentle spraying of the surface of the wound with a mild antiseptic is permissible. The use of a counterirritant on the adjacent tissues, if indicated, is not objectionable. The practice of continually disturbing a wound with instrumentation or with strong drugs cannot be too severely condemned. Later, when satisfactory healing is apparent, the patient may use a mouth wash for its cleansing effect, and I might add, for its psychic effect. As washes are countless, there will be no difficulty in appeasing the whims and fancies of the most exacting dentist and fastidious patient.

How, now, are we to treat the perverse wounds, wounds that do not heal properly? We all know that, in spite of the strictest observance of asepsis and adherence to the fundamental principles of surgical technic, and with traumatism reduced to a minimum, we still have wounds that break down and are annoying to both patient and operator. This is usually accompanied by persistence of pain and local inflammation. This condition, or the so-called "dry socket" is sometimes due to the use of hydrogen peroxid. In my opinion, this drug is contraindicated as a postoperative wash since it acts as a blood-clot solvent.

The condition of delayed healing having developed, we must meet the situation by proper treatment. Cautious irrigation of the wound with mild antiseptics is carried out to dislodge any débris that may have been retained within the confines of the operative field. Useless granulation tissue has to be cut away, and when the wound is again set in order, the application of sedative drugs and a gauze dressing will, in most cases, afford relief. The dressing is changed as often as conditions require, until sound healing has again been resumed. At this stage of the case, the application of heat externally usually affords the greater comfort.

When postoperative treatment is complicated by general bodily disturbances, the problem looms larger and demands more exacting consideration. For instance, prolonged bleeding, as found in hemophilia, is a subject which might in itself occupy the space and time of another symposium. Suffice it to say that, in known cases of hemorrhagic diathesis, constitutional treatment, under the care and with the cooperation of the patient's physician, is instituted before attempting any surgical operation such as is now

under discussion. Mere superficial bleeding may be arrested by placing some gauze over the orifice of the wound and having the patient keep the jaws closed over it for from fifteen to twenty minutes. If bleeding is somewhat more persistent, firm packing of the sockets with gauze will often be sufficient. If the bleeding is from a part of the alveolar process and the field can be readily approached, it may be checked by crushing the bone at this point with a blunt instrument. Suturing of the wound will be of material aid. These methods are tried before the use of drugs, the majority of which have a deleterious effect on the supporting and adjacent tissues. When bleeding is prolonged and becomes alarming, a combination of all of these forms of treatment must be resorted to. The administration of morphin and atropin is a valuable adjuvant in the treatment of hemorrhage.

CONCLUSION

Every case should receive the same attention in postoperative care as in the performance of the original operation itself—care which is not to be relaxed until the operator is satisfied and the patient discharged. We must not forget that there is more to be considered for the benefit of the patient than the mouth into which we daily peer with so much concern and interest. An appeal to his intelligence will gain cooperation, and a few minutes of simple nontechnical explanation of your instructions to him in what you expect of him will add materially to the chances of recovery. Constant diligence and intelligent care must be exercised in the treatment of our cases from the beginning to the end.

410 Professional Building.

DISCUSSION

Theodor Blum, New York City: I have nothing to say except one word in regard to localization of roots as well as foreign bodies by means of the roentgen-ray. We will say that this line represents the alveolus, and we have our film on this side [illustrating]. We can easily decide whether we are dealing in the maxilla with a buccal root or a palatal root by taking two or three roentgenograms. If the work is on the buccal side, the roentgen ray is directed at right angles to the film. The roots will appear in this position. If we let the rays come from an anterior direction, the root will move away from the first position, and, in the same way, if we let the rays come from the posterior direction, they will always move, because the body is away from the film. If, on the other hand, the roots are near the palate and the rays come in this direction, the root will stay close, no matter what direction the rays come from. It will stay close in the same position, and in this way we can localize any foreign body much more easily than by introducing any piece of steel or any foreign bodies into the gum or any other part, because it gives as little an idea as to the position of the foreign body as if we placed a mandibular needle in the mandibular region to localize a broken needle. This method is employed after we have taken two pictures at right angles and are not convinced as to the position of your root.

Menifee R. Howard, Denver, Colo.: A simpler procedure in localization in an edentulous case would be, instead of preliminary suturing, which would necessitate pain, or injection of procain, the use of metal attached to the gum with ordinary adhesive tape, which will hold a sufficient length of time. Then, by the use of the method suggested by Dr. Blum, definite results can be had in localization.

Dr. Proctor (closing): I should like to report to the society a certain treatment for tic douloureux that has come to my attention. It is new as far as this country is concerned. I had occasion recently to refer a case, in which I had previously given alcohol and the operation for resection of the branches of the second and third division had been performed, to Harvy Cushing of the Peter Bent Brigham Hospital for gangliectomy. In discussing the tic douloureux, he gave me this information about a product made in Germany called chlorylen, a chemically pure product which has been compounded from chemical trichlorymene. It is interesting to

note how this was discovered. The workmen employed in repairing airplanes used this solution for cleaning the wings. It was found that occasionally they were overcome by the fumes of this commercial product and were unconscious for a period of a few hours, and when they recovered, there was complete anesthesia of the sensory branch of the fifth nerve. With that as a background, a chemically pure product was obtained, and it has been administered for about five years in hospitals in Berlin and Hamburg. The method of administration is simple. It is given in doses of from 15 to 20 drops for fifteen minutes three times a day for a period from three to four days to a week. In the incipient cases, it works very successfully. In chronic cases, the period of anesthesia may last practically for the same time as that which results from alcoholic injection, or may not be effective at all. In the incipient cases under a year's duration, as far as reports from across the water are concerned, there has not been recurrence in five years. So it really makes an effective and simple method of treatment for this type of case. The only danger which may enter into the administration is that it may render the patient slightly nauseated, and also there may be some syncope. For that reason, it should be given in a recumbent position and the patient kept under observation at the time. Even though it is only a fifteen-minute period, the treatment should be under the supervision of the nurse as well as under the care of the physician. This drug may be obtained in New York from a man who imports it, H. J. Kirschner, 34 Third Avenue. It has been used at the Peter Bent Brigham Hospital in Boston for about nine months or a year and has been a success in these recent cases. Because of difficulty in obtaining a sufficient amount from Europe, a similar product, called gemalgene, is made by a Boston concern, the Davies-Rose Company, Ltd. The reason they began to work on this was that there was a stoppage of the drug from across the water for three or four months. I learned within a day or two of coming here that this concern is now prepared to put out this drug. Their address is 24 Thayer Street. In two cases that I have seen at the Brigham Hospital, in which they used a small amount of the drug, it was effective, and I will be glad to report to any of you at a later date. The dose is from 15 to 20 drops on a sponge or gauze. The patient is allowed to inhale that for about 15 to 20 minutes three times a day, for a period of from two to three days to a week. It may be done at home under jurisdiction or observation, or the patient may be sent to the hospital. It is carried out as a routine practice at the Brigham Hospital.

Dr. Lewis: Does this put the patient to sleep?

Dr. Proctor: No, the patient does not lose consciousness. At the hospital, the nurse stays in the room while the administration is going on. I presume that if the patient began to lose consciousness, the nurse would remove the drug.

A CONSERVATIVE USE OF SILICATE CEMENTS*

By D. N. LEWIS, D.D.S., Lake Forest, Ill.

SILICATE cements have passed through a long experimental stage. They have become more popular year by year until now there is a trend not toward a more conservative, but more extensive, more radical and more indiscriminate use of them. This is almost appalling, and yet it is easily accounted for in two ways. The patient is pleased and relieved because of the comparative ease and the beautiful effect of the operation; and the dentist is pleased and relieved because of the comparative ease and the beautiful effect of the operation. What could be simpler? In both cases and to both parties, the eventual result is seemingly of minor importance.

This is not intended as a criticism of material, patient or dentist; it is a mere statement of opinion, and a plea for a more thorough study of this material and its practical possibilities.

The use of silicate cements is now so widespread in dentistry that they are worthy of a more serious study, and their consideration deserves a great deal more time and space in our programs and periodicals than it has hitherto been accorded. Any material that meets with so much popularity is justly entitled to a careful analysis, free discussion and fuller publicity of the facts in the case.

The facts in this case, as I see them, are derived from the theories of chemists; the reports of the manufacturers' research laboratories; the clinical findings in our own daily practices, and the resultant information that we impart to each other.

Time is a great factor in determining the value of a product. We cannot individually enter into the secrets of patented processes of manufacturing. Ours is a different field of endeavor, and we must take the materials as they are presented to us and follow the instructions provided by the producers. It is only an instance of perfect folly for us to pit our little individual theories about silicates against the broad scope of concentrated effort on the part of the engineering chemists who have studied theories, recorded experiments by the thousands and developed a standardized technic for our use. To be sure of our results in practice, let us most carefully follow the teachings of those who have paved the way for us. I do not mean to say that we should not study and learn, record and report results from our own clinical experiences. I urge that we keep ourselves energetically awake, eagerly grasping for any knowledge and advantage that we may gain through our own ingenuity, and our individual and combined efforts.

But who among us in daily practice can sacrifice the time and advance the

*Read before the Section on Operative Dentistry, Materia Medica and Therapeutics, at the Sixty-Ninth Annual Session of the American Dental Association, Detroit, Mich., Oct. 26, 1927.

funds to work out the facts contained in this statement?

From a technical viewpoint the aluminosilicates are of particular interest in connection with this subject. Not only are the powders of the silicate cements typical aluminosilicates, but the baked dental porcelains are also compounds of this type.

The aluminosilicates are important in the commercial production of porcelain, because the essential constituents of porcelain are kaolin and feldspar, both of which are typical aluminosilicates. When heated alone, kaolin does not melt, and it requires the addition of a more fusible substance such as feldspar to lower the fusing point so that the whole may melt and form the translucent mass commercially know as "porcelain."

The porcelain body used in crown and inlay work is composed of silica (silex), feldspar (orthclase), kaolin (clay), and either flint glass (a silicate of potassium or sodium and lead), or Bohemian glass (a silicate of potassium and calcium). The chemical composition of commercial porcelain varies widely, but from a chemical standpoint they are all aluminosilicates. While porcelain varies widely in its chemical composition, the physical properties of the various porcelains, such as translucency, hardness and insolubility, are essentially alike for all porcelains and in this regard the silicate cements may be described as chemical porcelains, since they have these characteristic physical properties. They are not baked dental porcelains, since, instead of requiring the application of heat and the addition of flux to agglutinate the more refractory bodies and thus bring out the physical properties, in the case of the silicate cements, or chemical porcelains, these characteristics are developed by mixing a silicate powder, which takes the place of the refractory body, with an acid-salt liquid, which takes the place of heat and flux combined.

I have cited this much abstruse information to call your attention to the fact that we are dealing with a subject and material that has a vast amount of scientific thought and careful study back of it. And we, in general dental practice, might as logically insist on proving or disproving the multiplication table before using it as to make an attempt to prove or to disprove these statements.

Let us admit frankly that a real need for a translucent filling material has existed since dentistry began, and as soon as a reasonably serviceable product was developed, it was eagerly taken up and used, with little inquiry into underlying principles on the part of either the dentist or the patient. In recent years, we have been learning to appreciate the merits and the demerits of the modern silicates, and it is high time that we develop a "silicate sense" about where and how to use them.

KEEPING SILICATES AND INSTRUMENTS FIT

The greatest possible emphasis should be placed on the care of these materials in order to secure the best results. There is but one correct method for handling each silicate cement, and that method is given with full particularity by the manufacturer. To vary from his method or directions is to invite trouble and possible failure. The processes for each are not complex when once learned, but quite simple, and results are reasonably certain, in proportion as producers' instructions are followed. Master the directions and follow them absolutely.

While in minute details they differ, there are certain general principles that are equally applicable to all silicates; for instance, absolute cleanliness is imperative. They all agree on that. No foreign element must be allowed to come in contact with the powder, the liquid or the plastic material. Do not touch with the hands or fingers. No matter how clean or recently washed they are, there is always a supply of insensible perspiration and sebacious secretion from the skin which would contaminate the filling material.

The powder bottle must be kept stoppered, and the liquid bottle must be se-

curely covered at all times, and its mouth and neck kept scrupulously clean and free from liquid or deposits.

The mixing slab, the spatula and the packing instruments should be clean, not only clean looking, but actually free from any traces of oil, grease, moisture, finger marks or any other foreign substance which might contaminate the silicate.

In my practice, I use an agate spatula only, but for packing instruments, I use either agate or noncorrosive metal. These instruments and the slab are kept strictly for the use of silicates, and under no circumstances used for other materials.

I am reporting to you the words of a silicate manufacturer when I say "The spatula must be of agate. No other kind will do. Don't use an ivory, bone or shell spatula. A metal spatula is under no circumstances permissible." And having followed these instructions for fifteen years with satisfactory results, I see no reason for using any other than agate spatulas.

Never dip the spatula into either the liquid or powder bottle. Always pour the powder from the bottle, and use the dropper to convey liquid from bottle to slab. Put the dropper back into the bottle immediately and do not fail to replace immediately and securely seat the glass cover or cap on the liquid bottle to prevent evaporation or absorption. Never return to the bottle any liquid that has once been on the slab, and never take liquid from the bottle until you are ready to use it.

The powder bottle also should always be instantly covered after only the necessary amount for a single mix has been removed.

The shade-guide should be kept clean and free from soil, stain or discoloration.

WHERE TO USE AND WHERE NOT TO USE SILICATES

There is, no doubt, a considerable difference of opinion as to where silicates should be used. I shall indicate where I use them in my own practice, reporting where I find success and where failure; and I urge you to report your cases.

The very light shades of powder (No. 1 or 2) give a most gratifying service when used in the pulp chamber and lingual surface of pulpless anterior teeth, both upper and lower. The opaque guttapercha root canal filling is removed well rootwise to the gum line, and the crown, if badly discolored, is well cleaned out. Then the light translucent silicate is used to tone down the discoloration and give the tooth as nearly normal appearance as possible.

Occlusal pit and fissure cavities in bicuspids and molars afford excellent protection for silicate fillings and when the proper shades are used, the teeth are well preserved and present a normal, natural appearance. They serve well in buccal and lingual pit cavities in molars.

Some of the silicates are used with success and great satisfaction in the setting of porcelain inlays and porcelain jacket crowns.

In the proximal surfaces of anterior teeth, they can be made to resemble tooth structure so closely as almost to defy detection.

On the proximal surfaces of bicuspids and molars, their use is doubtful, especially if there are opposing teeth. On the angles of anterior teeth, the use of silicates alone is not indicated, but they may be used in combination with gold inlays. In gingival third cavities in anterior or posterior teeth, the use of silicates is doubtful. In mesioclusodistal cavities in any teeth with normal occlu-

sion, the use of silicates is positively contraindicated.

Also, my experience and observation indicate that they should not be used for mouth breathers or people who habitually sleep with their mouths open. Likewise, they should not be used in compound cavities involving the distoclusal surfaces of third molars.

I am aware that the material is recommended for some or all of these positions by some enthusiasts, but my personal experience does not permit me to be so venturesome.

The satisfactory or the disappointing results attending the use of the silicates may be found in the order as named.

HOW TO USE SILICATES

1. When the cavity is accurately and neatly prepared, with clean, clear, sound floor and walls, with enamel margins not beveled but sharp, and the full length of the enamel rods well defined and well supported by sound dentin, with proper undercuts distinctly formed in at least two opposing walls of dentin, we are ready for selecting the shade.

2. A fine matching of shades can be obtained only when a tooth is free from shadows of decay, free from surface stains and mouth débris. In fact, the tooth should be polished to its normal or best reflective color; and for an anterior tooth, the shade guide should always be used. The tooth should be covered with moisture as in the natural environment. The shade guide should also be moist as the filling is expected to be in the tooth. If no one shade corresponds to that of the tooth, a happy combination of two or more shades should be selected that will so closely blend in with the color of the tooth that the vanity of the most hypercritical patient will be gratified, and the artistic taste of the delighted dentist will be gratified.

3. Everything required for this filling should be placed within easy reach on the bracket table. All instruments and materials should be ready for instant use.

4. The most effective means of excluding moisture from the filling while it is being inserted should be employed. The silicate producers tell us that the powder and liquid are so delicately adjusted, or so perfectly balanced for a completely satisfactory chemical reaction, that even the moisture of the breath on the freshly mixed silicate can do no good and may do much harm. That means that the rubber dam should be used for every filling, if possible. I do not adhere to this rule so rigidly as some operators who say, "No dam, no filling," but I do, in every instance, take every possible precaution to exclude all moisture from the cavity and the silicate while the filling is being made, and for several hours thereafter. I can safely and constructively propound this as a practical and rigid rule: "Some moisture, no filling; no moisture, some filling."

5. If there are any old silicate fillings in the dry area, they should be covered with cocoa butter or varnish.

6. After the cavity has been prepared and protected from moisture, it is wiped out with a dry pellet of cotton. Mind you, I did not say dried out, but "wiped out with a dry pellet." It is then flooded with phenol. This is sometimes done by dipping the pliers into the phenol and carrying it in that way to the cavity; and again saturating pellets of cotton and carefully wiping the floor, walls, angles and undercuts of the cavity, so as to cover thoroughly the exposed end of every dentinal tubule. The operator

thus endeavors to cauterize and sterilize the contents of the outer orifice of each tubule.

7. I never use alcohol in a cavity prepared for a silicate filling. I use only phenol, cotton pellets and air at room temperature; not hot air nor even warm air, and only a small amount—two to three blasts. There should be no free moisture left in the cavity, but it should not be so thoroughly dried as to leave the tubules thirsty and eager to absorb a portion of the liquid from the silicate.

8. I seldom use a cavity lining, and still more seldom use a cement base; but I do not hesitate to use either lining or base if the cavity appears to be dangerously deep. Some dentists seem to think that I must be reaping a harvest of dead pulps; but through these ordinary precautions in my placing of silicates, I have never had occasion to accuse them of devitalizing a single pulp.

9. The next procedure in this operation is to begin the manipulation of the silicate cement itself. The powder is poured from the bottle upon the right end of the slab. If two or more powders are required for the proper blending of shades to match the tooth, the second and smaller batch of powder is placed just a little to the left of the first, and so on until every powder that is going to be used in the mix is lined up on the glass slab, and every bottle instantly re-covered.

10. The liquid is then placed, in quantity for the mix, on the left end of the slab. The liquid is not poured from the bottle, but is conveyed from the bottle to the slab by use of the dropper. The original contents of the dropper should be expelled two or three times before the liquid is placed on the slab. Firmly seat the cover on the bottle.

11. Mixing is started at once, no time being allowed for the powder to become contaminated from the dust in the air, and no time for the liquid to become concentrated by evaporation nor diluted by absorption of moisture from the atmosphere.

12. Mixing is continued until the consistency is that of putty or bread dough, it being thick enough that it will curl up over the back of the spatula as it is drawn across the mixture, and yet thin enough that it will show a little moisture rising to the surface as the mass is gently patted down with the spatula.

13. The time consumed in mixing should follow closely the instructions prescribed by each manufacturer for his own material.

14. The filling should then be packed into the cavity in the time specified. It should first be packed with suitable instruments into the undercuts, the most diligent care being employed to avoid incorporating air into, or under, the filling.

15. The filling should be slightly overdone, that is, the cavity should be filled to a slight excess. In the case of a pit or fissure cavity, a ball burnisher is used for final condensing and smoothing away the excess.

16. For proximal cavities, the celluloid strips serve well for condensing and shaping the filling to the surface of the tooth. The strip should be thinly coated with cocoa butter on the cavity side. Often, the strip can be placed in position between the teeth before the filling is packed. This is an advantage, especially where there are two cavities facing each other in adjoining teeth. The uncoated side of the strip is folded back over one cavity, while the other tooth is packed with the silicate and puddled slightly to bring the loose granular surface to a

condensed and glossy sheen. The strip is then folded over the filling the mass of which should be a little in excess, and drawn around the tooth with a steady pressure and firmly held in place for three minutes. An effort should be made to express all excess of the filling, letting it squeeze out in any direction until the strip lays flat and uniformly against all surfaces of the tooth just outside the cavity. Only one filling should be made from one mix. If two or more fillings are attempted from one mix, it is more than likely that none of them will receive the proper attention before the initial stages of setting begin.

17. After the strip has been held securely for three minutes, it is carefully released and eased away from the margins and finally taken away in such a manner as to not distort the margins nor the bulk of the filling.

18. The glossy, smooth surfaces are now covered with cocoa butter.

19. Allow the filling to remain undisturbed from ten to fifteen minutes.

20. Some of the manufacturers tell us that it is better to polish away this high glaze on the surface made by the puddling process and by the smooth surface of the condensing celluloid strip. They say that the deeper bulk of the filling is harder and less susceptible to disintegration by the saliva. Concerning the time for polishing, I am aware that some of the manufacturers tell us that the silicate filling should not be polished at the same sitting at which it is made, but should be left until a later time. I appreciate the chemical reasoning for the suggestion and I realize how readily it is accepted by many operators, because it is reflected in the great number of silicate fillings in the interproximal spaces, and other places, too, which have never been polished at all. I find I can polish the fillings in the interproximal spaces more neatly and more comfortably to the patient while the rubber dam is in place than I can at a later sitting, when gums, mucus and lips are all in the way; and if the patient is not coming soon for another sitting, any roughness under the free margin of the gums may cause more or less irritation and injury. If we wait the ten or more minutes as directed, and then polish the interproximal fillings while the rubber dam is in place, I believe, from fifteen years of observation, that we can confidently expect better results.

All polishing equipment, such as fine stone, cuttle fish strips and disks, should be kept thoroughly lubricated with cocoa butter while being used on the filling. Disks are run at low speed, and a quick, light, touch and lift motion are employed in order to lessen frictional heat.

21. When all margins are smooth and continuous with the surface of the tooth, the filling should be coated with a covering which is impervious to moisture, such as a solution of cellulose in amyl acetate. This covering should be carefully spread over every part of the filling, and then thoroughly dried with air before attempting to remove ligatures and dam. No doubt some very good fillings have been spoiled by the way in which the rubber dam was removed. When I see a filling with a rough and pitted surface, or deep disintegration in the center of a filling near the contact with another tooth, I wonder if that misfortune has occurred from a failure to get the varnish thoroughly over the filling and dam; or whether it may be the result of some chemical or galvanic action generated by the secreted contents of the saliva.

22. When the ligature is to be removed it should be cut on the side of the knot nearest the filling and drawn endwise around the tooth, not over the fill-

ing, but kept rootwise to the filling until the end of the thread has passed out of the interproximal space.

23. The rubber dam should never be pulled off over a silicate filling. It should be drawn labially and gingivally until that portion of rubber passing between the teeth can be cut with scissors and then drawn lingually and labially from the spaces, for fear of disturbing the covering and thus giving the moisture of the mouth an opportunity to injure the silicate.

24. The dam and ligatures cannot always be removed without disturbing this covering. In these cases, immediately dry the filling and again cover with the protecting varnish.

25. The patient must be instructed to leave that coating on the tooth and over the filling for several hours. I usually tell them not to brush that tooth, nor chew against it, nor touch it with anything until the next morning. I tell them to leave it until the next day without disturbance, and the filling will be a better one; and that they may then brush and use it as a normal tooth.

26. Some of the manufacturers report that their product continues to harden for twenty-eight days, but that the moisture of the mouth does not injure or interfere with the increasing hardness after the first ten or twelve hours.

27. There are many important points of interest and value regarding the silicate fillings which cannot be written into one paper. I would, therefore, urge that if there is any doubt about any point regarding any of the silicate filling materials, the dentist write to the manufacturer of that particular silicate which he is using, and I am sure they will gladly give all possible assistance.

DISCUSSION

M. L. Christensen, Oshkosh, Wis.: I am in accord with Dr. Lewis when he says that the use of silicate cement fillings is now so widespread that they are worthy of a more serious study, and deserve more time and space in our program, and also when he says that any material that meets with so much popularity is justly entitled to a careful analysis, free discussion and fuller publicity of facts. The character of the material and its manipulation has been so well described here and the manufacturers have so stressed the importance of care in each step of the filling, that there is not much that can be added. I would suggest that the greatest of care be used in safeguarding the life of the pulp. Owing, no doubt, to improvement in the material used, we do not see the evidence of pulp deaths that we saw some years ago; but I do not believe I am too conservative when I say that some suitable lining should be used in the bottom of every cavity unless it is very small. Turning from the question of how these cements should be handled, let us see when and where their use is proper. That there is a legitimate place for silicate cements cannot be denied, but there is no question that they are today being used in a great many cases where another material would be far preferable. Their overuse has caused many to wonder whether the net results are beneficial or detrimental. Silicate cement fillings cannot be considered permanent, as compared with gold foil or amalgam fillings, porcelain or gold inlays. Regardless of how the material is manipulated, or where it is placed, the immediate or temporary results are almost always pleasing to both patient and operator from both an esthetic and an operative point of view. This, I fear, is tempting many of us to use it indiscriminately. As a consequence, we are losing some of our digital dexterity and take the easier course. We see examples of the shortcomings of this material in our practice every day, such as labial or buccal fillings with margins extending below the gingiva, presenting a rough or etched surface. We also see the same results in large proximal fillings extending below the gum line. In such locations, silicate fillings are contraindicated, yet how many such fillings we see. Another unfavorable condition coming to our attention is the drifting together of teeth

having large approximal fillings, due to disintegration of the material, with consequent loss of contact point and interproximal space. If we were always as painstaking in our technic as described in the paper and more conservative in our selection of cases, so many defects would not be encountered. It is my belief that small pit and fissure cavities in bicuspids, and especially in molars, are better filled with gold foil or even amalgam. Large proximal cavities in the anterior teeth where esthetics is a factor may be restored with porcelain inlays to better advantage, contour and contact being thus maintained. Silicate cements serve a useful purpose, if limited to well chosen small cavities in the six anterior teeth, in buccal cavities in bicuspids, in filling the pulp chamber in pulpless teeth and in repairing or replacing facings in crowns and bridges. Beyond this, their use is highly questionable. The manufacturers are to be commended for producing and improving the material to its present state, and we hope such improvement may continue. Silicate cements are being used in too wide a field and it is time that we paid as much attention to ethics in the use of the material as we do to esthetics.

C. W. Strosnider, Columbus, Ohio: There is encouragement in the thought that the gold foil fillings, which silicate cements have so widely and universally replaced, can show only an average specific gravity of ten or thirteen. This being the case, there must have been sufficient air spaces making the differences between these fillings and the actual specific gravity of hammered gold, which is 19.4, as to result in a leaky and defective filling very soon after insertion. Dr. Lewis points out that it is folly for us to pit our little individual theories about silicates against the broader scope of concentrated effort on the part of the engineering chemists, with their many theories and experiments to back them up. For the most part, I can agree with Dr. Lewis in this, but there is still a great tendency on the part of the manufacturers and their chemists to overemphasize the value of their products in making claims as to what their products will do. This holds true more especially with silicate cements than with any other dental product on the market today. We are all familiar with the claim of a certain manufacturer as to the wonderful and lasting results obtained by the use of their silicate cement in such cavities as those involving the incisal angles of the anterior teeth, and they even advise and recommend the use of their silicates in making jacket crowns. Now if you can make a nice jacket crown with silicate cement that will stand the test of time, then I am willing to believe that certain cigarettes will not irritate the most delicate throat and will inhibit dental decay. Dr. Lewis also quotes a chemist when he says: "The porcelain body used in crown and bridge and inlay work is composed of silica, feldspar and kaolin, and either flint glass or Bohemian glass. The chemical composition of commercial porcelain varies widely, but from a chemical standpoint, they are all essentially aluminosilicates. While porcelain varies widely in its chemical composition, the physical properties of the various porcelains, such as translucency, hardness and insolubility, are essentially alike for all porcelain, and in this regard the silicate cements may be described as chemical porcelains since they have these characteristic physical properties." But do they? If we do grant that silicate cements have the same physical properties as those of crown and inlay porcelains, we certainly cannot concede that two of these properties, hardness and solubility, are anything alike in resistance. Dr. Lewis further quotes this chemist by saying, "They (the silicates) are not baked dental porcelains, since instead of requiring the application of heat and the addition of a flux to agglutinate the more refractory bodies, and thus bring out the physical properties, in the case of the silicate cements, or chemical porcelain, these characteristics are developed by mixing a silicate powder, and an acid or an acid-salt liquid, which takes the place of heat and flux combined." Now, as to this point, I do not believe that the liquid of a silicate cement takes the place of heat and a flux in carrying these substances to maturity, because the end products are not any more alike than isinglass and glass. Dr. Lewis states that another manufacturer says that "when the powder and liquid of the silicate cements are properly mixed, they become practically chemically inert." This, no doubt, is true but they are not chemically resistant. And so it would seem that, while the dental profession is using large quantities of silicate cements and filling porcelains, we are not at all satisfied with the products the market affords today. And it is, therefore, to be hoped that the manufacturers will keep

persistently at it, with the hope that a great improvement will be made in the future. I have not discussed the main part of Dr. Lewis' paper, for he has handled the technic of the subject sufficiently well that no particular discussion of it is necessary.

THE LAWS OF ARTICULATION*

By FELIX A. FRENCH, D.D.S., Ottawa, Canada

PROSTHETIC dentistry being my chosen specialty, I was particularly interested in convincing myself of the benefits accruing from the establishment of balanced articulation. My experience forces me to conclude that the subject is equally important to all branches of dentistry which in any way involve form and formation of the masticatory surfaces or the physiologic and psychologic effect of form and formation on tissues and patient, respectively.

Neither devices, instruments and instrumentation nor chair and laboratory technic will be my subject, but I shall confine myself mainly to the question of the development and usefulness of the basic principles underlying the problem of restoring or reconstructing the masticatory surfaces. In particular, I shall sound the merits of the laws governing balanced articulation.

Many members of the dental profession have earnestly endeavored during the last decade to master that part of denture prosthesis which applies to the formation and alinement in restoration of the masticatory surfaces by using the ordinary sources available. Nevertheless, the present status of denture prosthesis seems to be that which is so well described by an editorial in THE JOURNAL[1] which says:

> There is one subject in dentistry today which stands sadly in need of standardization. In connection with this subject, there is more confusion in the minds of the profession than regarding any other, unless it is the perennial question of pulpless teeth. We refer to full denture construction. In our literature in recent years, this topic has been treated extensively; in fact, it is well within the mark to state that more articles have been written about full denture work than about any other topic. And yet, in the face of all this, and in spite of the consideration that has been given it, there seems to be as much uncertainty as ever in the minds, not only of the profession as a whole, but also of the full denture men themselves.

The editor depicts the present status of full denture prosthesis: an analogous situation prevails in partial denture prosthesis, periodontia and orthodontia, partly because of similar conditions.

I concur that we dentists have unnecessarily, possibly unwittingly, been working in the wrong direction during the last decades. Men in authoritative and quasi-authoritative stations tried to solve the instrument and instrumentation problem by whiling away their time with discussions of unimportant elementary details. As I see the situation, there should be no need for such waste of energy, because the problems of physics and instruments involved presented no difficulty to those trained for the task. The problem of instrumentation became an exceedingly aggravating one on account of the

*Read before the Section on Full Denture Prosthesis at the Sixty-Ninth Annual Session of the American Dental Association, Detroit, Michigan., Oct. 26, 1927.

1. What Is Wrong? J. A. D. A., 14:1116 (June) 1927.

great variation in instrument designs, which traces its origin to misinterpretation of the fundamental principles involved in the physics pertaining to prosthesis and the modification of form and alinement of natural and artificial teeth.

Three investigators, F. H. Balkwill, physician and dentist, of Great Britain; Alfred Gysi, a dentist, of Switzerland, and Rudolph L. Hanau, a mechanical engineer, of Buffalo, N. Y., have contributed in consecutive steps the bulk of our understanding of the principles involved in the physical function of masticatory surfaces.

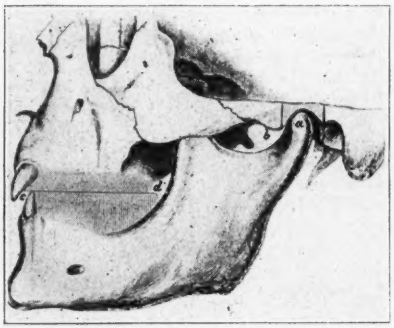

Fig. 1.—Centric relation associated with centric occlusion.

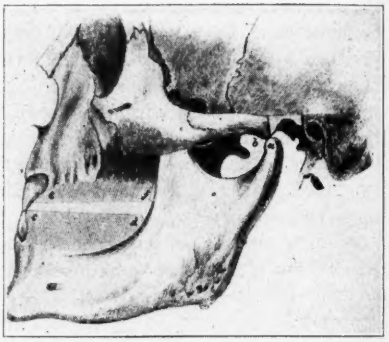

Fig. 2.—Protrusive relation associated with protrusive occlusion, showing loss of contact in second molar region due to steep condylar guidance.

Balkwill gave a remarkably concise presentation on articulation before the Odontological Society of Great Britain, June 4, 1866, and Gysi added valuable points. With the advent of Hanau, who had to disprove many accepted views of his precursors, a revolutionary change in the practice of denture prosthesis has occurred. Hanau has placed denture prosthesis on the scientific and practical foundation that was needed.

Balkwill's presentation contains remarkable original data. In the light of his comprehensive paper, most word battles over articulation published during the last few decades approach the fustian and are justly dwarfed into insignificance.

Balkwill, in his Figures 1, 2 and 3, illustrates the principles involved in protrusive movement and his Figure 4 illustrates the component movements in lateral movement correctly. We may not agree to the sequence of these component movements as he describes them. However, there can be no scintilla of doubt that Balkwill had the right conception of the resultant lateral movements of the jaws; he clearly proves it by Figure 5, showing the arrow point design which graphically demonstrates the right and left lateral movement for points and surfaces, respectively, all along the dental arch from the mesial to the distal aspect. Figures 6, 7 and 8 suffice to show that Balkwill and his contemporaries had a conception of tooth form which compares well with our present understanding.

Gysi investigated the arrow-point trac-

ing very carefully, proved it, added the condyle tracing demonstrating anterior strokes and incorporated these tracings in his adaptable articulator technic. Gysi's publications pertaining to this subject extend over the period from 1909 to 1919, forty-three years after Balkwill's publication. In 1920, Hanau appeared on the scene. He quotes Gysi's work as his starting point, crediting it with being the most logical of his prosthetic references. At that time, Balkwill's writings were not known to Hanau. They were not known to me until very recently. I owe to Hanau the opportunity of presenting these illustrations.

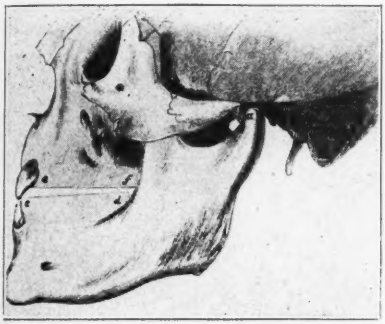

Fig. 3.—Protrusive relation associated with protrusive occlusion, showing second molar region more nearly in contact owing to condylar guidance being less steep.

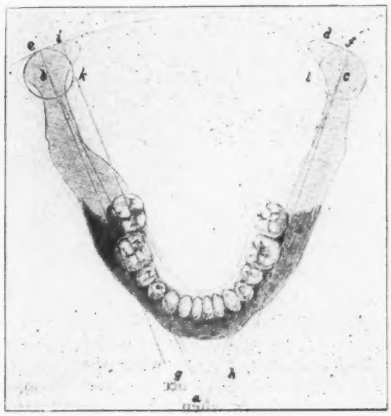

Fig. 4.—View of the lower teeth and diagrammatic section of the outline of the lower jaw, looking at it from above. *a*, center of circle *e, i, d, f*, which forms the boundary of the condyles behind. *b, c*, centers of the two circles *e k, l f*, parts of whose circumferences form the external angles of the condyles. The teeth when drawn to the left side, for instance, on that side, first move on the lines *a d, a c*, and then on *a c, c h*, and reciprocally on the opposite side.

A close study of Hanau's work reveals that Balkwill's conception and Gysi's interpretation of mandibular movements are substantially correct, also that the Christensen intra-oral wax-bite method, if modified, is well suited to making mandibular measurements, while Gysi's adaptable extra-oral method for adjusting an articular mechanism is not satisfactory. Hanau's deductions are based on the contention that articulator movements should not reproduce anatomic movements (as was the time honored belief), but that they must be the equivalent of the anatomic jaw movements. He reasons thus because restorations are seated more or less resiliently in the mouth, while the resilient effect is entirely eliminated by the rigid plaster mounting in the articulator. This new thought and the technic Hanau gave for measurements relegate all previous technic as either wrong or incomplete without the consideration of the resilient and like effect in the relation of instruments to instrumentation.

According to a vogue sponsored and widely practiced, it was the general rule to select high cusp teeth and provide a deep overbite. However, when the dis-

astrous effects of such indiscriminate practice became too evident, new authority deemed fit to advocate "lower" cusps at times, also a "more shallow" overbite. In consequence, one camp still adheres to the deep overbite; another to the shallow overbite, and still another camp prefers to apply the shallow as well as the deep overbite, with high or low cusps, respectively.

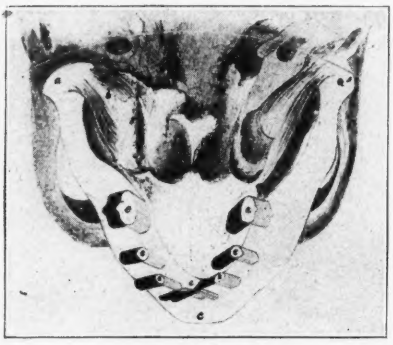

Fig. 5.—Facial part of skull viewed from below with outline of lower jaw left blank, *a c a*, drawn to the right side by the left pterygoid muscle, *b*. The white spaces, *e, e, e, e,* are the positions occupied by the tops of the lower teeth when at rest; the shaded spaces to the right of these show the lateral motion of the teeth from rest to the position supposed to be occupied by the jaw in the figure; the black spaces to the left show the reciprocal action when the other muscle alone acts. The shaded and blank spaces on each side of each blank space show the limit and direction of the lateral motion of the teeth. The alternate teeth have been omitted to avoid confusion.

The vacillating views regarding overbite, overjet, cusp height, etc., which existed, were accepted and still persist here and there among the rank and file, are mainly responsible for the deplorable state of affairs prevailing throughout the profession. The hard pressed dentists (including the specialists) are forced to make such choice, "as may be required by the individual case," which usually is explained or has to be interpreted: "determined by the operator's good judgment."

According to Hanau's summary of a survey,[2] published in December, 1926, our good judgment went astray more than ninety-five times in 100, or, as I

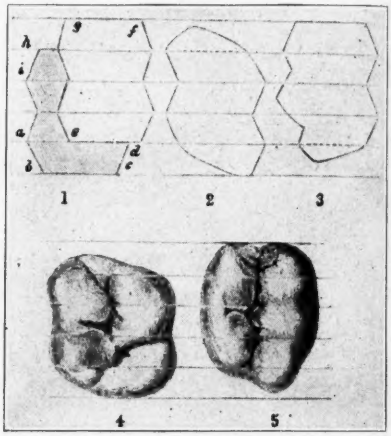

Fig. 6.—Diagram to explain the particular form and articulation of the upper and lower first molars. 1. Ideal diagram of the surface of a lower molar, *g e d f*, in position upon an upper, *h b c*, showing that if the cusps simply alternated, the part of the upper *a b c d* would be unoccupied. 2. Masticating surface of upper molar, showing how the external cusps are brought forward. 3. Masticating surface of lower molar, showing how the lower molar is extended back by the addition of an extra cusp. 4 and 5. Masticating surfaces of upper and lower molars of the left side in their relative positions, showing that the fifth cusp of the lower would fall just behind the transverse ridge of the upper.

2. Hanau, R. L.: Articulation Defined, Analyzed and Formulated, J. A. D. A., 13: 1694 (Dec.) 1926.

was personally informed, 999 times in 1,000 cases, to be mathematically correct. The history of the one case which was correct does not add any laurels to our professional achievements.

I may add that some of my own cases picked at random were included in the mentioned 999. I was unaware of my deficiencies at the time. That I was unaware of my errors and that they were the products of a universal handicap, our lack of informative resources and training may be my only consolation under the circumstances. A decided change of conditions now prevails, thanks to Hanau. He succeeded not only in giving us definite laws of articulation by which we can interpret our technical problems in denture construction and restoration, but he also contributed accurate instrumentation and instruments which enable us to analyze the situation and diagnose many phases of new and finished cases heretofore not correctly interpreted.

Correct measurement on the patient, skilful use of the face-bow and articulator and a mastery of the laws of articulation solve many a problem with remarkable facility and give us a chance also to tackle problems of less, equal and greater importance.

THE ARTICULATION QUINT[3]

The articulation quint is a graph coordinating the five main factors incorporated in the main laws of articulation and governing the establishment of balanced articulation. The quint indicates the influence of two single factors on each other, while the three remaining factors are not changed.

The method of expressing the reciprocal relation of only two single factors and assuming the balance of factors involved to remain unchanged is a customary procedure. It simplifies the solution and explanation of a problem, without interfering with practical application.

It is difficult, in fact, it is confusing, to endeavor to convey an understanding of the change of one single factor under the influence of two or more factors changing simultaneously, for the latter may each change in a degree and direction which magnifies, minimizes or nullifies their combined influence on the single factor. It should not perplex the beginner that it may be difficult to manipulate one single factor without slightly affecting another factor which in a law is assumed to remain unchanged. The laws of articulation are primarily an analysis, a dissection and an explanation of the principles involved in alining teeth in balanced articulation, and as such are indispensable to the mind which directs the hand.

There are many factors in the establishment of balanced articulation. Nine of these have been given consideration.[2] Of these nine factors, the five most important in the practice of denture restoration were incorporated in the quint. The laws given in the quint apply to the construction of prosthetic masticatory surfaces and to the restoration of prosthetic as well as natural dentures, provided it is the aim to obtain "balanced articulation."

The five main factors are: 1. The inclination of the condylar guidance. 2. The prominence of the compensating curve. 3. The inclination of the plane of orientation. 4. The inclination of the incisal guidance. 5. The heights of the cusps.

Each factor comprises an anatomic part (or its equivalent) undergoing a

3. Hanau, R. L.: Dental Engineering (revised), published by author, Buffalo, 1926.

relative change; i. e., either an increase of, or a decrease of: (a) the inclination of the condylar guidance, of the plane of orientation or of the incisal guidance; (b) the prominence of the compensating curve; (c) the heights of the cusps.

The full meaning of the large arrows in the middle is given in each sector of

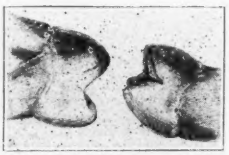

Fig. 7.—Cusps showing their bulging form, which to a great extent saves their points, the enclosed edges which have to resist the direct force of the bite, being more obtuse than the free edges. Thus, the inner edge of the upper molars and the outer edge of the lower are much blunter than their respective opposites.

the quint. The four small arrows, two on each side of the large middle arrows of each sector, relate the influence or change caused, thus: all arrows pointing away from the center indicate an in-

Fig. 8.—Ordinary porcelain molars nearly as wide at the top as at the base, thereby incommoding the tongue and requiring increased power to force it into food.

crease of the relative change, while those pointing toward the center indicate a decrease of the relative change.

Having five factors, each of which may increase or decrease respectively, it is mathematically possible to express forty relations (or laws in this case). These forty laws may be divided in ten groups of four each. Each group contains a main law and its three transformations.

The ten main laws of articulation as recorded below will facilitate study and practical application; their transformations are self-evident from the example of transformations which I shall explain presently.

TEN MAIN LAWS OF ARTICULATION

1. An increase of the inclination of the condylar guidance increases the prominence of the compensating curve.

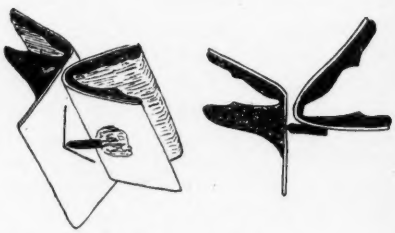

Fig. 9.—Gysi's mandibular tray with gothic arch tracing.

2. An increase of the inclination of the condylar guidance increases the inclination of the plane of orientation.

3. An increase of the inclination of the condylar guidance decreases the inclination of the incisal guidance.

4. An increase of the inclination of the condylar guidance increases the height of the cusps progressively toward the posterior.

5. An increase of the prominence of the compensating curve decreases the inclination of the plane of orientation.

6. An increase of the prominence of the compensating curve increases the inclination of the incisal guidance.

7. An increase of the prominence of the compensating curve decreases the heights of the cusps progressively toward the posterior.

8. An increase of the inclination of the plane of orientation increases the inclination of the incisal guidance.

9. An increase of the inclination of the plane of orientation decreases the heights of the cusps equally or nearly so.

10. An increase of the inclination of the incisal guidance increases the heights of the cusps progressively toward the anterior.

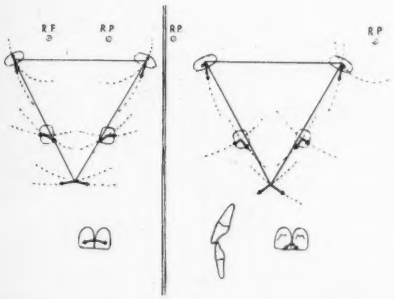

Fig. 10.—Diagram showing how the positions of the rotation centers influence the form of the gothic arch tracings. (Gysi.)

THE SIXTH LAW OF ARTICULATION AND ITS TRANSFORMATIONS

As read in the sector of the compensating curve: an increase of the prominence of the compensating curve increases the inclination of the incisal guidance; reversed: a decrease of the prominence of the compensating curve decreases the inclination of the incisal guidance.

As read in the sector of the incisal guidance: an increase of the inclination of the incisal guidance increases the prominence of the compensating curve; reversed: a decrease of the inclination of the incisal guidance decreases the prominence of the compensating curve.

It should always be understood, when mentioning a law of articulation, that its transformations also apply.

The quint and this abridged description are given for practical application. The laws of articulation apply to tooth form and position both anterposteriorly and in any direction from one condyle socket through the denture.

As an instance of practical application: A glance at the articulation quint tells us that the prominence of the compensating curve is increased: (1) by an increase of the condylar inclination; (2) by a decrease of the inclination of the plane of orientation; (3) by an increase of the inclination of the incisal guidance, and (4) by a decrease of the heights of the cusps toward the posterior.

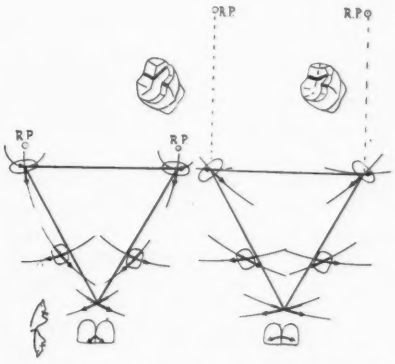

Fig. 11.—Diagram showing how the positions of the rotation centers influence the form of the gothic arch tracings. (Gysi.)

The various transformations of these laws also answer the question put in reverse form or formulated in the negative. Do we need more concise answers as to

the relation of the compensating curve to the mentioned factors?

Each sector of the quint has the advantage of absolute succinctness and tells a long and useful story within a minute fraction of a printed page.

The laws of articulation apply to the construction of artificial masticatory surfaces and to the repair and rearrangement of natural and artificial masticatory surfaces, wherever the establishment of balanced articulation or its modification is desired. In my opinion, they are one of the finest contributions to dentistry and constitute the solution of that part of our problem which for so many decades has perplexed most research workers and teachers. Hanau's laws of articulation are to dentistry what elementary laws of dynamics, statics, electricity, etc., are to physics. Their wise application enables us to find and understand readily the physical limitations for a choice of tooth form, tooth modification, tooth position and tooth alinement, thus emancipating the operator from contradictory claims and questionable statements. The dentist conversant with them may justly feel that his opinion pertaining to the problems of articulation is elevated from speculation to a logical deduction.

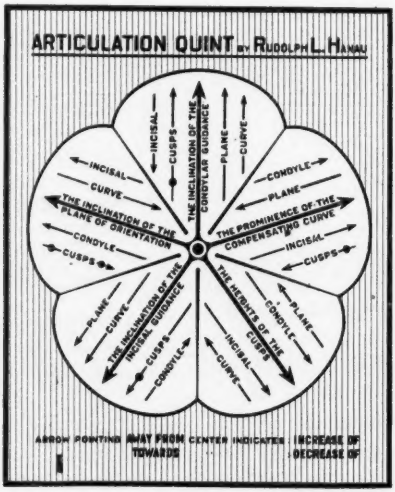

Fig. 12.—Articulation quint.

DIET AS A FUNDAMENTAL IN DENTAL CONDITIONS*

By PERCY R. HOWE, A.B., D.D.S., Boston, Mass.

DIET is one of the live topics of the day. The mass of information on the subject which reaches the eyes and ears of newspaper and magazine readers and radio listeners would seem to indicate that there is little left to be learned about it. The schools and colleges send out an army of more or less trained dieticians whose pronouncements are accepted as scientifically correct, and guaranteed to produce health and long life.

Although eating has been one of the important occupations of life since the beginning of human existence, and although the last few years have witnessed an unparalleled amount of research on this subject, it is apparent to any thoughtful person that even we of the age of much information still have something to learn in the matter of diet. We hear much of the lengthening span of human life and of the achievements of medicine in overcoming tuberculosis and typhoid fever, but we also hear that caries and cancer and degenerative diseases are on the increase, and that our young people have many structural defects of the jaws and other parts of the body framework which may be the result of rickets or similar diseases of childhood.

The medical and dental professions have attacked these problems from many angles. The favorite field of investigation for the last fifty years has been that of bacterial causes, and no one will deny that, within certain sharply defined limits, much has been accomplished and that there is hope for the future; yet our hospitals are increasingly crowded, and the professions are busier than ever. Many plausible excuses are offered for this condition of affairs, such as the stress of modern living—too little time spent in fresh air and sunlight—and various mechanical faults which alter developmental tendencies. I have no wish to ignore these causes or to belittle their effects, but the experience of a number of years in the laboratory has convinced me that they have been overestimated, and that the original underlying primary cause of many of our troubles is faulty diet.

Each one of the myriads of cells which are the chemical laboratories of our bodies requires food for its maintenance and for its work. These are the workshops of life. Here, there are no five-hour days nor five-day weeks. The work goes on ceaselessly—it begins with life—indeed is life itself — its end spells "death." Reproduction, growth, repair, the elaboration of specific chemical products, the disposal of waste constantly goes on in this hive of industry. All the raw materials for these intricate processes are derived from food; not one of the necessary elements can be spared. That fact

*Read before the Illinois State Dental Society, Rock Island, May 11, 1928.

is so obvious that we need not dwell on it, but other facts equally important but less obvious should not be forgotten; i. e., the necessary elements should be in a form readily assimilable and in somewhere near proper proportions, and the serum which bathes the cells should be free from unnecessary or foreign or toxic substances.

It is considered a wonderful feat to grow tissue outside the body. This is done by feeding the cells with fresh raw serum from young growing animals. Serum contains not crude foods but food that has undergone resolution, by what we call digestion, into elementary factors suitable for cell purposes.

What all these factors are we do not know. We do know some of them, and we are learning about others. Adult serum will not promote cell growth in tissues. The serum must come from young animals. Stale serum will not do; it must be fresh. The cells in tissue cultures must be assisted in the disposal of waste products by frequent washings with properly prepared solutions, else they will die.

How nicely adjusted the solutions which bathe the cells must be is seen when they are washed. If the solution is too concentrated, the cells shrink; if it is too weak, the cells swell or even burst.

The careful adjustments which are necessary in a solution designed to promote cell life outside the body ought to suggest to us that somewhat similar care should be employed in producing serum which is to bathe the cells within our bodies. I do not mean that we should go about with a balance in one hand and a test tube in the other, prepared to test every bit of food that we consume; I mean that we should have as detailed a knowledge as possible of the elements that make up our common foods; that we should know the effect of the various elements on the cell, and that we should choose accordingly. The idea that Nature will pick out of the mass whatever she cares for, and discard the rest, has been overworked.

When foods have been tested in living animals, it has been found, in a few instances, that very definite effects on the cells are obtained. For example, a deficiency of fat-soluble A causes the odontoblasts to lay down bone instead of dentin; which indicates that the odontoblast is merely a specialized type of bone cell or osteoblast. This results in a less dense and resistant calcification of the tooth structure.

The process which follows a deficiency of fat-soluble A goes no further than this reversion of odontoblast to osteoblast. The osteoblasts are not affected as far as we can see, and hence no bone changes have followed. All the pathology of our experimental animals has been interpreted by Professor Wolbach. Another and indeed the strikingly characteristic change which follows this deficiency of A is that glandular and duct epithelium, in a great part of the body, is replaced by a common type, i. e., a stratified, keratinized, desquamating epithelium. Glands, including the salivary glands, thus become unable to perform their proper function, and, in the case of the salivary glands, the saliva is changed.

The work on fat-soluble A has been done principally on rats. Recently we have succeeded in training guinea-pigs to eat purified foods and the same changes occur in the guinea-pig, but more promptly and more markedly than they do in rats, though localized somewhat differently. The same tooth changes occur.

A few days ago, Dr. Noyes of Chi-

cago visited the laboratories and, in examining a section of a human tooth, said: "Why! here is an area of bone in the dentin of this tooth." I had entirely overlooked it, but since we have found that bone is laid down instead of dentin on a fat-soluble A deficiency, this anomaly in a human tooth was very suggestive.

Another striking change in the odontoblasts occurs when animals are fed diets deficient in the antiscorbutic vitamin. In a few days, from five to seven, the odontoblasts may be seen to have ceased forming dentin and the pulp to have shrunken away from the formed dentin. After a few more days, the formed dentin is resorbed or liquefies. On the administration of orange juice, new formation begins within twenty-four hours, and, in a few days, the space between the pulp and old dentin is replaced with new dentin. What really happens is that, during a deficiency of the antiscorbutic vitamin, the cells in supporting tissues of the body cease to form intercellular substance. Their recovery on the administration of the missing factor is very marked. The process appears to be one like the jelling or setting of a liquid.

It is often said that we see no scurvy nowadays. It is true that we see but little shipboard scurvy, but I believe that a latent unrecognized scorbutic condition is very prevalent. The pasteurization of milk destroys the antiscorbutic factor, and I know of no infant's food which contains it except mother's milk. Now animals on these two deficiencies do not show such changes merely now and then; animal after animal on these diets have defective teeth.

Another change in calcified structures occurs in rickets. The cause of rickets is still uncertain. Experimentally, it has been produced by a lack of calcium or phosphorus in the diet and is thought to be due to an unbalancing of the calcium: phosphorus ratio, or to the lack of an antirachitic vitamin.

As a preventive, cod-liver oil has attained a prominent position. In experimental rickets produced by feeding a high calcium and low phosphorus diet, or a type of rickets which is not often found in human cases, cod-liver oil has a pronounced therapeutic effect. Wilson, in a report of the roentgenographic examination of many infants and young children, states that 97 per cent of the children examined showed bone changes notwithstanding the fact that they had received biologically tested cod-liver oil. A recent report of six cases from the Children's Hospital in Boston cites cases in which cod-liver oil was found in the lungs at necropsy. The pneumonia found was in reality due to this oil, as discovered by Dr. Wolbach. It is well known that any number of animals, including men, have had excellent teeth and bones without taking cod-liver oil. Because of the rather general repugnance which its taste inspires and because of its tendency to upset digestion, I have hoped that a substitute might be found. Perhaps we shall find some way to avoid the seeming necessity of using it.

Our laboratory experience leads us to think that a diet of properly chosen food elements will produce a perfectly normal animal organism. While there has been an enormous amount of work designed to find such a diet, the disagreement among investigators and the finding of new food elements, such as the vitamins, clearly shows that we are still uncertain as to the relative importance of many food factors. Therefore, it is not wise to speak with too great definiteness regarding specific factors, but we do feel

warranted in making suggestions along general lines.

Because of the prevalence of tooth and bone defects, we have been especially interested in the whole subject of calcium metabolism, and Sherman's statement that modern diets are more deficient in calcium than in any other factor has seemed particularly significant. It should not be supposed that the calcium needs of the body can be met by the simple process of supplying lime in large quantities to the digestive tract. Absorption, assimilation and fixation are complicated processes in which many food factors are probably involved. We have already shown that the antiscorbutic vitamin plays a prominent part in the fixation of lime in the teeth and bones, and that a deficiency of fat-soluble A has a deleterious effect on dentin formation through the change from odontoblast to osteoblast.

Some of our foods containing only a fair amount of calcium leave an acid residue in the body. The metabolic end-products or ash of meats and of cereals consist of acid radical of phosphoric, sulphuric and hydrochloric acids. A part of the calcium intake is utilized to neutralize these strong acids before any storage takes place. With our diets already low in calcium, this additional drain on the bases of the body can have only a deleterious effect on tooth calcification.

We hear a great deal about the necessity of meat as a protective food or source of protein, and recently also of cereals in the same capacity. We used to think of cereals as starchy foods, but we now realize that they contain almost as high a percentage of protein as meat itself.

The idea that we require rather large "protective" amounts of protein has become so thoroughly entrenched in the American mind that it requires a certain temerity to attack it in any way. Even vegetarians have felt that they must substitute for meats other foods of high protein content, such as nuts, cheese and the like. Advocates of a low protein diet have occasionally lifted their heads and even offered a few experiments to show that the danger of low protein was a bogey, but they have made little headway. However, our own experiments with guinea-pigs show that a high protein diet results in poor, fragile teeth—teeth with pitted enamel—and that the animal often dies showing gallstones at necropsy.

In this connection, it is well to recall the amount of protein in human milk. This is the most perfectly constructed food for all bodily requirements during the period of most rapid growth. Human milk contains about 2 per cent protein. Cow's milk contains but 4 per cent. In a recent review, the London *Spectator* remarked that low protein was winning out all along the line.

On the whole, our experience in feeding laboratory animals leads us to believe that the outstanding fault in our diet is the excessive use of meats and cereals to the exclusion of sufficient fruits, vegetables and milk. The latter foods contain vitamins, mineral salts and low protein, and in our experience with the experimental animals, they produce sound teeth and bones.

Primitive races, among whom practically no dental disease is found, know nothing about calcium lactate and parathyroid extract. They do not devitalize their foods by refining and preservative processes, and then try to supply the deficiencies by chemical makeshifts.

Nor should we, especially during the tooth forming period; in the mother, during the time of pregnancy and lactation, i. e., the period of temporary tooth formation, and in the infant, while permanent teeth are forming. There is no substitute for human milk for the infant, and the wonder is that with the young placed so early on artificial food, the teeth are as good as they are.

The very great incidence of caries today, after our most painstaking measures of prevention, fairly drives us back to a consideration of those fundamental processes concerned in building teeth of a resistant structure.

COOPERATION BETWEEN THE ORTHODONTIST AND THE GENERAL PRACTITIONER*

By ABRAM HOFFMAN, D.D.S., F.A.C.D., Buffalo, N. Y.

THE subject of cooperation between orthodontist and general practitioner seems elemental and almost capable of summation in the few words, "Do unto others as you would have them do unto you." Still, there are so many ramifications and divergences that a thoughtful person could spend far more time in this presentation than that allotted.

I am primarily a dentist; secondarily, a specialist; therefore, I may be termed a free lance—in a position which permits bringing out the points pertinent to this subject. Admitting at once that there are two types of practitioner, the question arises as to the legal status in the relationship of these types.

Law is defined as a rule of action established by recognized authority to enforce justice and prescribe duty or obligation. The obligation of the general practitioner is that he possess ordinary knowledge and ordinary skill in everything pertaining to his practice; whereas, it is the duty of the specialist to so specifically inform and qualify himself as to know practically everything about his specialty and to possess more than ordinary skill and knowledge —a rather envious advantage in favor of the general practitioner, and in view of this, one must reflect and wonder why so many men are eager to pose as specialists. The law, then, grants any dentist the right to practice any of the specialties of dentistry. Nevertheless, no one has a right to announce himself as a specialist without adequate study and the acquisition of proficiency and skill.

The thoughtful, conscientious, truly professional gentleman places another evaluation on his services before he thinks of his legal rights: such a practitioner first considers his moral and ethical status in the community and in his chosen work. There is no objection to the family dentist's practicing in the specialties, but remember that even though there is but an occasional attempt to perform special service, the legal, moral and ethical obligation is that the dentist so doing shall have more than ordinary knowledge and skill. The pseudospecialist has no place in modern health service, and he may find himself mulcted in heavy damages be-

*Read before the Section on Orthodontia at the Midwinter Clinic of the Chicago Dental Society, Jan. 26, 1928.

cause of his lack of preparation. There is a rung on the ladder for each of us.

Two or three decades ago, the dentist who did not attain a name for himself in all branches of dentistry was not looked on as an outstanding figure. Today, the condition is the opposite: our field of endeavor is broadening so rapidly that it is next to impossible for one to qualify in all branches, and because of this many men have associated for mutual benefit. The "group practice" is the result of this, and its principle affords a background of general practice, which is so desirable in many cases where conference or consultation is indicated. Our slogan should be "the welfare of the patient," and, without question, if more general practitioners availed themselves of the services of the specialist, their clientele would be much better cared for.

One who is successful in the specialties soon builds a practice independent of references from the dentist and receives the greater part of his work through his satisfied patrons. When this position is attained, the family dentist in the case should not be lost sight of, and the specialist should promptly refer the patient back to him for all branches of practice not in the special field. There should be frequent and free communication regarding the conditions which develop, and, in this manner, much of the strained relations which now often develop would be avoided.

There seems to be quite a growing tendency for the orthodontist to become a pedodontist. I am not sure but that there is some merit in this practice, especially in those instances in which the family dentist does not care to do children's dentistry or does not possess the patience necessary in caring for children. There are many orthodontists who definitely do not care to do *all* the child's work, and it therefore seems that this recent addition to the specialties has a legitimate field.

The mouths of certain children seem to require eternal vigilance in the effort to ward off caries. This statement holds good in those cases whether orthodontic appliances are present or not. Why is it, then, that so many dentists assume the prerogative of "taking a fall" out of the orthodontist by intimating to the parent that the appliances are the cause of caries or that there has been contributory negligence? This certainly is not the correct spirit, which should be one of cooperation. The occlusal pit and fissure cavities and most cases of proximal caries can rarely be charged against the appliances; nor should the characteristic acid disintegration at the gingival line which is so common before and at the age of puberty be a direct charge. It may be that the stimulation resulting from the appliance has been a contributing factor, but there probably is, in most cases, a deeper etiologic factor, which is systemic and in which general health, food, nutrition and so on play a part. Censure of the orthodontist by the dentist in these instances is almost sure to ruffle some one and result in unpleasant feelings. On the other hand, the characteristic white surface softening of enamel caused by unsanitary appliances and improperly cemented bands is the fault of the orthodontist, and he is subject to criticism for allowing such conditions to develop.

The inexperienced orthodontist too frequently places his apparatus in mouths below par as to health, and when he does so, either from ignorance or for mercenary reasons, it is time for the family dentist to consult with his brother practitioner in the interest of

the patient. For the best interests of all parties concerned, there should always be free counsel and cooperation in these cases.

Every orthodontist who handles a large number of cases has experienced the difficulty of getting the dentist to place a mouth in first-class condition before setting appliances. It is all too frequently said "Those cavities are too small for fillings" or "Those teeth will be shed so soon that they are not worth filling." A most unusual case recently came to my attention. The dentist refused to extract badly broken down and abscessed deciduous molars "because they were needed to preserve the size of the jaws." He evidently had a hazy recollection of something once heard in this connection, but his application of a principle was very poor. He did not realize that the orthodontic appliance would be not only a space maintainer but a means for stimulating growth and development of the supporting bone as well. It is not always folly to be wise where ignorance is bliss. In this instance, it is needless to say the child was saved from absorbing any more toxins from these teeth, and the dentist probably lost a patient.

If the great majority of dentists had a deeper interest in and a keener appreciation of the deciduous dentures, and made an earnest effort to preserve these precious teeth to their full term, one intelligent family dentist could do more to ward off malocclusion through preventive measures than a dozen orthodontists can remedy by corrective measures after the malocclusion is once established. Dentists should understand the deciduous teeth better: this subject is not sufficiently stressed. However, if the orthodontists were to give papers or lectures on the purposes, care and management of the deciduous teeth, they would be about as popular as a sore thumb. This would, however, result in another kind of cooperation than is indicated by the title of this paper. Instead of being circumscribed and between ourselves, the result would be a contribution by our profession to the health and welfare of mankind.

During the past few years, the layman has come to realize the importance of the deciduous denture as regards the child's health, and its related importance to the permanent denture. As a result of this fact, the family dentist is seeing more of these dentures, and relatively earlier and in greater numbers than heretofore. He is accordingly expected to display a keener appreciation of their development, preservation from caries, the loss of their members or the invasion of perverted arch form and function. The dentist's opportunity thus comes early in the cycle, and if he is alert to the conditions of normalcy and abnormalcy, he is in a position to render valuable cooperation.

No dentist should expose himself to the criticism that is sure to follow with a disfigurement of a permanent denture, or facial inharmony in later life, as the result of speculative advice. It is inexcusable to delay orthodontic treatment arbitrarily until adolescence or maturity, for, by that time, irreparable damage may be done. Most experienced orthodontists prefer to start operations at a relatively early age, being governed by their judgment as to the mode and extent of treatment to be carried on. The best time to correct any ailment is in its incipiency, other physical conditions being favorable.

When perversions creep in, it may well be said that troubles never come singly. It is more than probable that

early treatment will not be a universal panacea and therefore we should leave the thought with the parent that we may again, at a later age, have to assist Nature; and if we do, we will only be taking up the case where we left off and will not then be confronted with an abnormality of long standing and too firmly established to be responsive.

Often, a simple expanding device placed upon one deciduous arch (preferably the lower) will react sufficiently through its forces and the forces of mastication to expand the other arch. This applies particularly to those narrowed arches with the permanent incisors erupting in rotated positions; which should not be confused with arches of sufficient lateral development wherein the incisors seem to be erupting in labial or lingual positions; for these are quite apt to be self-corrective through the pressure of the tongue and lip muscles and the influence of the inclined planes. In these early treatment cases, the roots of the deciduous second molars (to be determined by roentgenographic examination) may still be of sufficient length to withstand the requirements of anchorage and thus leave the developing permanent molars free from appliances.

Again, the permanent molars are often seen to erupt almost vertically, one above the other; but if the arch relationship is normal, these teeth soon assume their proper mesiodistal relationship. If the arches are malrelated, there is a different story, and corrective treatment should be started at once. The vertical height or development of the first permanent molars is an extremely important matter. Consideration here calls for careful or mature judgment, for the extent of the overbite and the vertical development of the lower third of the face is largely dependent on these teeth. One of the most perplexing problems (overbite) of the periodontist centers around this condition, and the importance, in general, of these teeth cannot be overestimated.

Never extract a deciduous tooth to make room for its successor without being sure of your diagnosis: It is too much like "robbing Peter to pay Paul;" but when you are sure of your ground and your judgment is supported by roentgenographic examination and other evidence, you may be justified in extracting deciduous teeth that are delaying the eruption of successors or deflecting them to abnormal positions. Fragments of teeth are usually better out of the mouth than in.

It is easier to direct a growing tooth to place than to move a fully developed one. On substantiation, the extraction of a deciduous molar is sometimes indicated in order to permit an adjacent developing tooth to be moved mesially or distally through the forces of mastication. Many permanent cuspids are robbed of their quota of space because of the too long retained larger (mesiodistally) deciduous molar or molars, they occupying more space than their succeeding bicuspids.

Too much stress cannot be placed on the thorough consideration of the case before any treatment whatsoever is undertaken. There should always be a complete set of roentgenograms. These may reveal many conditions not thought of, and these films prove themselves silent cooperators in our behalf. Congenitally missing teeth and supernumerary teeth have been an unforeseen pitfall with many orthodontists in the past.

If the permanent lateral incisor is congenitally missing, it is considered safe treatment to extract the deciduous lateral and cuspid to allow the permanent

cuspid to move mesially and thus erupt in closer relationship to the first incisor. If a bicuspid is known to be absent, we may be governed in our management of the deciduous molar, probably extracting it, and having the first permanent molar replace it. This is considered by some operators as rather radical practice, but if it is adhered to early enough in life (up to about 8 or 9 years of age), it is safe practice.

Basically, we advocate early treatment, but the following is an instance wherein it is better to wait. Picture a patient at from the eighth to eleventh year of age, with a protruding, rotated upper lateral incisor, so positioned because the incisal tip of the permanent cuspid or its enveloping sac is in contact with the incisor root. It would be unwise to try to "straighten up" this tooth or to rotate it as long as the contact referred to exists, as we might cause absorption (if not already present) of the lateral's root. It is far better to withhold treatment until the contact is relieved. The procedure indicated is to extract the deciduous first molar, releasing the developing first bicuspid, (which is undoubtedly the culprit that has been crowding the developing cuspid forward), and thus we relieve the pressure which has been bearing on the lateral. An extraction of this nature relieves the crowding, and the cuspid will probably renew its eruption in the desired direction. This condition may account for the noneruption of many cuspids.

There is another familiar clinical picture wherein much the same condition prevails. We have all seen the characteristic large "swelling" evident when the permanent cuspid appears to be developing labially to, or "on top of," the lateral incisor root; which results in one type of the "buck tooth." The treatment by extraction is the same as above outlined, and is particularly indicated if the patient is wearing orthodontic appliances.

It should be definitely remembered that the extractions referred to apply to deciduous teeth and that such procedure should be followed only as the result of painstaking diagnosis, careful and mature thought and a judgment not always displayed on the part of the operator. Most cases of premature loss of teeth invite the consideration of space-maintaining appliances. The indiscriminate extraction of teeth, either deciduous or permanent, cannot be countenanced. Indeed, such a theme as "Conservation of the Teeth as a Factor of Cooperation Between the Dentist and Orthodontist" would offer a healthy topic for discussion.

Orthodontia is the least understood and most faultily practiced branch of dentistry undertaken by the general practitioner. There are several reasons for this and they can probably be summed up under two heads.

In the first place, the average dentist chooses to look on the correction of malocclusion solely as a mechanical proposition, thinking that, if he can once penetrate the veil of mystery enshrouding the miraculous mechanical mechanisms used by orthodontists, he will attain marvelous momentum in the movement of teeth. This is all nonsense; for the skilful orthodontist uses the simplest apparatus possible in order to promote growth and development of the arrested or perverted tissues. The first condition then is a misconception of the whole purpose.

In the second place, there is something to be said about understanding the nature of the problem. We may put

alcohol in our automobile radiators in the winter to keep the cooling solution from freezing, and it works; but if we do the same thing in the summer, the engine overheats, backfires, burns out bearings and we stall in our tracks. The use of this illustration as an analogy is just this: no matter how diligently we may treat a case, unless we understand the nature of the problem—the cause, the diagnosis and classification of the trouble—our treatment will probably be incorrect, with failure for the end result.

So again we find a place for cooperation, this time for the orthodontist to do some plain sound fundamental teaching and for the dentist to accept the same with an open mind: lay the foundation before you shingle the roof. It isn't a case of what kind of lingual arch or bracket band or removable contraption will move the teeth—it is the question of what will accomplish the result in the most physiologic manner. Don't forget that physiologic laws should regulate our treatment before our treatment regulates the teeth.

No part is greater than the whole; thus, no specialty is greater than its parent branch. Thomas B. Hinman, of Atlanta, recently read an excellent paper dealing with cooperation before the New York Society of Orthodontists and a very apt summation of the situation was brought out. An old Southern colored preacher, on being asked what his idea of a specialist was, replied, "A specialist is a man who knows more and more about less and less." If that is the truth, then the general practitioner must be one who knows less and less about more and more. The fact of the matter is as intimated early in the paper: there is a place for each of us in the rapidly broadening dental field.

In the present-day vernacular, we hear the expression "Be yourself," which is to say, don't try to impress people that you are a specialist when the truth is that you are only especially interested in a certain line. It does not require much observation by a discriminating person to take the measure of a "poser," but the unfortunate phase of it is that the greater part of our people are not analytic. They place their confidence in those who possess the title "doctor," and this carries with it the inference that the holder is a member of a learned profession and is himself a learned man. What an unfortunate condition develops when a professional man fails to cooperate with his patient to the end that the best service be given in return for the confidence reposed in him! The general practitioner certainly should not lose interest in the work of the specialist, nor should the specialist lose interest in the work of the general practitioner. The ideals of all parties concerned should be recognized.

The best of us may meet with failure and the old adage "a change of pasture," etc., may be desirable, and when such a situation arises, the statements of patients should be accepted with reserve, for they may be very distorted and misleading. A wholesome conference will usually ameliorate many injured feelings. The ethics involved in summarily removing appliances that have been placed by another man, whether he is a general practitioner or a specialist, is open to criticism.

Then, too, how often do we find carefully made appliances ruthlessly ruined by wire cutters or band slitters under the excuse that they were loose and scratching the tongue or sticking into the cheek. Work, perhaps painstakingly done, is ruined in the twinkling

of an eye; and not only that: the patient will be subjected to a repetition of the steps necessary for replacement, with added expense. Such an act may undoubtedly be prompted by a desire to relieve pain or inconvenience, but does it not also savor just a little of lack of information and cooperation? And oh! how frequently have precious metal anchor bands been used as a matrix in the placing of amalgam fillings or these same fillings placed directly in contact with gold bands. It seems as though any one accustomed to using dental metals and alloys would realize the inevitable result because of the affinity of gold and mercury. The anchor band becomes amalgamated, the strength of the gold is destroyed in a very short time, the band breaks and is then worthless. Again, it is the patient who pays.

It is the duty of the orthodontist, and should unquestionably be his privilege if he so desires, to carry on the needed prophylactic measures for his patients, and this is particularly true if his office personnel includes a dental hygienist. It is also his privilege to practice prophylactic odontomy and treat superficial caries with silver nitrate, but if the specialist does not exercise these rights, in the best interest of the patient the case should be at once referred back to the family dentist. Many mouths become foul very easily during the wearing of appliances, and it should be the concern of all interested parties to see that cleanliness is maintained.

I am strongly in favor of teaching the child (and parent) thorough prophylaxis as a home procedure. The importance of this routine becomes all the more pertinent when we remember that probably 95 per cent of caries is initiated before adult life.

If it becomes necessary to remove the appliances for dental service, the dentist should from choice have the orthodontist do this work, but if there are extenuating circumstances, the specialist should gracefully acquiesce to any careful cooperative service which the dentist may render. There are dentists who, perhaps a bit thoughtlessly, request the orthodontist to remove appliances for quite minor operations and also quite frequently. It is hardly necessary to say that the orthodontist does not get any particular thrill out of this. When the dentist does remove apparatus, it should be carefully preserved and returned to the orthodontist. This is not always done and therefore may be classed as a lack of cooperation.

The matter of little courtesies rendered between professional brethren in the nature of emergency relief is worthy of mention. It is not always the best policy to promptly make a charge for these little courtesies. It usually leaves a wonderfully fine impression to say, "No, there is no charge for my attention. I am pleased to do it as a favor to you and as a courtesy to my friend Dr. Blank." We do not wish to convey the thought that there should never be a charge, for there may be cases wherein the spirit of cooperation would be misused or abused.

There is still another angle from which to consider this question of cooperation. It is with reference to dentists carrying on treatment as a matter of convenience for patients who live at a point distant from the orthodontist. As a basic principle, this is not to be advised unless the specialist has a great deal of confidence in both patient and dentist. The reason for this is clear. The average dentist does not possess the present-day orthodontic concept and

will find much difficulty in carrying out the plans and ideals of the specialist and, withal, the responsibility for the case is usually placed on the orthodontist. When an arrangement of this nature is entered into, there should be a very clear understanding between all parties concerned. The reasons advanced for such arrangements are quite apt to be more or less imaginary and not always well founded. The dentist who is well established in general practice usually has but little time to "dabble," and if he really wishes to undertake this class of work, it is his duty to avail himself of a proper course of instruction and then care for the children in his community in a proper manner. Such would be an evidence of progress. It certainly is an injustice to little children to have their teeth "tampered with," even though the effort may be in the spirit of cooperation.

What a sad commentary is recorded against the good name of dentistry when we note the great number of children who, for economic reasons, can never have the advantages of orthodontic treatment as the practice is now carried on. The plans for the future in dentistry must provide measures so that the correction of malocclusion, or better its prevention, will be of more universal avail. I have some very definite ideas along these lines, but time does not permit of their inclusion here. It is sufficient to say that "cooperation" is the key word and that it is entirely within the hands of the dentists, through their moral support of dental school clinics and other clinics somewhat especially organized, to place this beneficent service within the reach of countless thousands of children. The importance of our full cooperation in conquering malocclusion is evident, and the dentist who fails to take cognizance of the developing condition in its incipient stages is failing in his obligation to the public.

The question of the specialist's fee is often discussed between patient and general dentist and not always in a complimentary way. The skilled man should, without question, receive a better remuneration for his service than the one with but ordinary ability. Then again there is an established business principle which applies equally well in the professions—the question of supply and demand. The layman recognizes the value of orthodontic treatment (in many cases, in advance of the dentist), and the demand for this service far exceeds the supply of skilled operators. The result is obvious and needs no further argument. Still, the professional man who places a valuation on his services far in advance of his patrons' (or his own) social and financial position within the community deserves little consideration. Many specialists are carrying on a "wholesale business," and when this is applied to a practice of orthodontia, it usually results in a large number of unfinished cases and dissatisfied patients. "Moderation and cooperation in all things" is a good motto.

It seems impossible to keep the door closed on the old skeleton in the closet. Many young men entering the specialties (and some older ones, too), seem to think commission paying or fee-splitting is necessary for a start. This is a very perverted idea of ethics and certainly does not bear much evidence of cooperation, especially such as should exist toward a man who is willing to endure the privation which usually accompanies the first years of specialization. He should be receiving help rather than giving it at this time. In fee-splitting, both parties, the giver and the receiver, are guilty of a gross breach of

professional conduct. Let each party make his charge for the service rendered and be free from the stigma of deception, for the patient will become aware of the real situation sooner or later and the reaction will be most unfavorable.

Years ago, the American Society of Orthodontists went on record as being emphatically opposed to the practice of fee-splitting, and expulsion on conviction is the penalty for its practice by members. No one will be admitted to membership whose records bear such evidence. Practically every dental code of ethics prohibits this nefarious procedure; many states have laws prohibiting it under penalty of revocation of license; it is morally wrong; but still this monster persists to mar the fair name of dentistry. It is a relic of the days of charlatanism and should be relegated to the rubbish pile.

The spirit with which this paper has been prepared and presented has been one of cooperation and not separation. The thoughts have been expressed without fear or favor. If it does even a little toward bringing us closer together in our professional efforts and enables us to render a better service to posterity, its purpose will not have been in vain.

DISCUSSION

W. Ira Williams, Chicago, Ill.: The general practitioner virtually assumes the responsibility for every phase of dentistry. If he refers his patient to a specialist for a particular piece of work and something goes wrong, he has the wrath of the patient on his head. Then he has the task of selecting another man to complete the work or must try to patch things up for the specialist, if he still has confidence in the latter, and this can easily happen in orthodontia, where the treatment takes a number of years. Referring a patient to a specialist by no means terminates the responsibility of the general practitioner. The family dentist should never give the patient an opinion on such questions as when orthodontia treatment should begin; the kind of appliance to be used; the time it will take to complete the treatment, or the fees; for when the orthodontist tells the patient something different, it raises a doubt in his mind. The same rule holds true with the orthodontist dictating to the patient certain cavities to be filled and the type of filling to be used. These things could better be handled by a telephone conversation or letter between the general practitioner and the orthodontist. The patient does not always get the message straight. The orthodontist can check on an examination card or slip of paper certain teeth that he feels should have attention, and send it to the general practitioner by the patient without any comment as to procedure, and help him greatly. If he has some specific restoration that he wants done, he should communicate directly with the dentist. This is the age of cooperation and group service in every line. There is no doubt about the ideal being a group clinic or practice, each man doing a special piece of work but cooperating with his associates for the best interest of the patient. It is the tendency for the orthodontist to feel that his particular qualifications and skill justify him in charging a big fee, when the fee, in any case, is largely controlled by supply and demand, and the personality of the individual and his ability to "sell" himself to the patients; just as one man may get $50 for a gold inlay, while another will get $15 for just as good or maybe a better inlay. I do not think that the orthodontist is entitled to any larger fee for his time than is the general practitioner, from the standpoint of knowledge or skill. I have absolutely no use for a man who will try to get patients by splitting the fee with the general practitioner and I have less use for the general practitioner who will barter his patients. There are thousands of children in need of orthodontic treatment that cannot have it for economic reasons. The colleges and free dental clinics are waking up to this fact, and I hope that through the efforts of such men as Dr. Hoffman these unfortunates may soon be taken care of. It is also true, as Dr. Hoffman has stated, that we family dentists can prevent many cases of malocclusion by advising the parent to bring the child in early and by consulting with the orthodontist in the extraction or retention of the deciduous teeth. The general practitioner is unwise to attempt orthodontic treatment when the services of an orthodontist can be had; for the

former is not usually properly equipped for such work, and, under such circumstances, it is not remunerative and he is not best serving his patient. However, in the rural districts, the general dentist has to do orthodontic work if it is to be done. The orthodontist should brush the teeth, especially if he is changing the appliances, and should instruct the patient in the care of the teeth while the appliance is on, and if a deciduous tooth can be taken out without an anesthetic, he would usually please the family dentist if he would take it out, but he has no right to refer the patient to an extracting specialist without conferring with the family dentist. Cooperation would be much better if the general practitioner saw the patient at regular intervals also, and by all means when the appliance is taken off. Many times, cement is left under the free margin of the gum and sets up an irritation. I recently saw a patient three months after the appliances were off and found zinc cement under the free margin of the gums of a number of the teeth. It has the same irritating effect that serumal deposits have if left there. If, as quite often happens, bands work loose, and the patient has no appointment with the orthodontist for probably a month, the general dentist can assist the orthodontist by urging the patient to go immediately to have the band recemented. These are the cases in which cavities develop and the orthodontist is blamed. There should be definite cooperation in such things as the time of extracting of the deciduous teeth, thumb sucking, mouth breathing and other habits of children, in an effort to prevent malocclusion. C. N. Johnson has summed up the whole problem in the following statement:[1] "When the possibilities and significance of orthodontia are fully realized by the world, there shall be recorded for dentistry one of the greatest achievements and greatest tributes that have ever fallen to the fortunate lot of any calling." That prophecy will not be fulfilled until dentistry itself at large realizes these "possibilities and their significance and elects to assume the responsibility that they impose." Dr. Hoffman has consumed considerable space in a discussion of orthodontia which will be of interest to the orthodontist but is Greek to the general practitioner. However, we should be willing to learn more regarding these general points. I do not agree that the average specialist builds his practice from his patients. It is true that they tell their friends about him, but the friend usually asks his family dentist about the specialist. I cannot agree with the idea of the orthodontist becoming a pedodontist. I am also glad that, in the eyes of the public, the "would be" specialist is placed with the specialist instead of the general practitioner.

1. Orthodontia, Editorial, J. A. D. A., 13:125 (Jan.) 1926.

MAKING RECORDS FOR ESTHETICS IN FULL DENTURE CONSTRUCTION*

By EDWARD H. BRUENING, D.D.S., Omaha, Nebr.

THE essential steps in making records of the denture patient which will aid in producing the most satisfactory results in the construction of artificial teeth are as follows:

Two types of cases will be considered. The first represents a case in which the natural teeth are to be extracted. Four photographs are made in the dental operating room, one showing the face form and expression with the teeth in gentle contact; another with the lips slightly parted as in smiling; one showing the extreme exposure of teeth and the gingival tissue, as in laughing, and another showing a profile view with the teeth in occlusion. These pictures are

*Demonstration at the Midwinter Clinic of the Chicago Dental Society, Jan. 26, 1928, using 600 feet of motion picture film.

quickly and easily made with the use of a clinical camera and a focusing guide.

Impressions are taken with modeling compound in sections, where necessary, in order to obtain accurate records of the teeth and investing tissues. These are taken to a laboratory, and casts are made and mounted. The bite for mounting these casts is made with a piece of modeling compound as it comes from the box trimmed to fit the mouth. The labial portion is trimmed off and the compound replaced in the mouth to check the accuracy of the bite.

The hues for the artificial teeth are selected by comparing the moistened porcelain forms from the hue guide with the teeth in the mouth. The mold numbers are also selected by comparing the teeth from the mold guide with those in the mouth.

A plaster profile guide is made by placing the head in an almost horizontal position, and with the aid of a tin syringe such as is used for decorating pastry, plaster is gently allowed to flow in a line from the forehead to under the symphysis. This record is to be used when placing the occlusal rims and trying in the dentures and for subsequent comparisons to determine the amount of resorption or foreshortening of the face. Wire guides, natural size photographs and cutout cardboard can also be used for this purpose. The position of the central incisors can be recorded in the making of this record if so desired.

The casts have been mounted in the laboratory and are now ready for comparison with the case and notations can be made of characteristics, such as different hues that may be desirable, by markings on these casts.

Artificial restorations can be noted. Sometimes a reproduction of a gold filling or inlay is desired, and it should be placed as it was in the natural teeth, etc.

In the second type of case, let us suppose that the patient has been edentulous for a number of years, no corrections have been made and there is marked foreshortening of the lower third of the face.

The old dentures are examined and studied as to occlusion, form, color, etc. Snap impressions are taken, casts are made and base-plates and occlusal rims are fitted on them. These are adjusted in the mouth at the desired angle of opening. The Wavrin guide is then used to determine typal form. Guide lines to show the width of the six anterior teeth are made by placing a straight edge in line with the inner canthus of the eye and the alae of the nose, and the marking is made on the wax which represents the points of the cusps of the cuspids. Marks are made for the median and lip lines; then, the total width measuring from one tuberosity to the other. With these measurements, the size and type of teeth to be used are determined. The six anterior teeth from the mold guide are mounted on the occlusal rim to test the selection.

The hues are determined by the complexion classification method described by E. B. Owen, which classifies all patients into either the yellow or the gray group.[1]

A wire profile guide is made for the record of facial dimensions with the old dentures in the mouth; another one is made showing the corrections, and the two are compared.

Photographs are made before and after treatment. These aid the patient in learning to wear his new dentures as they show how much better his appearance is with the new dentures in position.

1. Bruening, E. H., and Owen, E. B.: A Study of Facial Form and Complexion Colors, J. A. D. A., 13: 1564 (Nov.) 1926.

CAPPING VITAL PULPS*

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THE variance of opinion regarding pulp capping is due largely to a failure to recognize fully the importance of the biologic laws responsible for the phenomena in tissue development. The operation of these laws must be understood before success can be attained in the treatment of these cases. We must know what the directing influences are that guide these various activities to their completion. Such knowledge would serve as a basis for the solution of many of the problems before us today. I regret that a knowledge of much of this is still lacking, although important steps in the advancement of this subject will be gained through the application of the knowledge of the sciences here involved. In this connection, we must not overlook the chemical process involved in the phenomena in cell development. There is a building up of new complex substances out of the simple elements or molecules present within the cell.

The cell envelop contains materials which are more or less permeable by the solution in which the matter is suspended. These solutions are known as crystalloids and colloids.

The state of equilibrium existing between them is readily altered by various influences, acting on the cell causing growth; or the disturbed equilibrium may cause an extrusion or secretion of some of the fluids within the cell body.

The extrusion or secretion of the fluids of the cell is purely a physical one, known as osmosis. The laws of osmosis are easily upset by various influences—by the attraction of the membrane as well as the behavior of the substance composing the solution. Cell multiplication results from this physiochemical process.

One can easily imagine that when conditions arise which interfere with this process or where there are even unsatisfied affinities of the molecules present, atrophy of the cells may follow.

All the operative forces of the process which influence cell activity are of biologic significance in the treatment of pulp involvement. It is through the physiochemical activity that building of the various cells begin. It may appear to some that such knowledge is of no practical value, whereas the method of procedure is often misdirected when this knowledge is lacking.

While the study of the cell properly belongs to the domain of citology, cell activity is essentially physiology, and this vital process should have a most important bearing on healing in pulp exposure.

It is not my purpose to treat this subject from a biologic standpoint, but rather to make brief reference to the value of these laws relative to this subject.

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From the harmonious activities of these various forces, the development of the cells results. These forces govern the growth, as well as regulating the size and form, placing each cell in its proper position and interlacing each body with its neighboring cell, building the structure and making all interdependent. The destruction of a number of cells may result where even a single cell ceases to function properly. This is the situation existing in pulp exposure, destruction varying only in degree in accordance with the extent of injury.

Before entering further into the discussion of this phase of the subject, it may be well to consider some of the cells that make up the pulp tissue, their function, histologic makeup and other characteristics. Since odontoblasts form the outer covering of the pulp and are the first involved in an injury, they are perhaps the most important cells to be considered at this time.

We are prone to think of all injured tissue as being capable of healing. Usually, this process does occur, but there are some cells of the body which do not regenerate, and the odontoblasts seem to be one of that kind. In the process of healing, scar or fibrous tissue is usually formed, although this does not occur in the injury of the pulp, at least not following the destruction of the odontoblasts. The process of healing is dependent on certain characteristics of the cells, and this quality seems to be lacking in the pulp tissue; yet the odontoblasts are capable of bringing about certain forms of repair, such as formation of dentin under favorable conditions. When slow destruction of dentin takes place, as in the wearing away of the dentin by mastication, a stimulation of the odontoblast follows, causing a recession of the pulp, and a deposition of dentin occurs. Since it is the function of the odontoblasts to form dentin, such results would naturally be expected, but the odontoblasts do not possess the qualities of regeneration.

Observation leads me to believe that when destruction of that part of the odontoblasts which exists in the tubules occurs, it ceases to function and atrophy follows. I believe this condition takes place whether the destruction is brought about by decay or mechanical means.

If regeneration of the odontoblasts does not occur, it cannot be expected that capping of exposed pulps will be successful. I am strongly of the opinion that such treatment is never permanently successful.

Owing to the fact that the pulp is made up largely of embryonic tissue, much should not be expected in the way of repair of the injured parts, for it lacks many of the necessary characteristics possessed by fully developed cells. The fact that this organ lacks these qualities indicates that it was never intended to function in this manner. I believe that it is hopeless to expect any method of pulp capping to be successful under such conditions.

I am fully aware of the fact that sometimes a pulp will remain vital after capping. This does not prove that such a result is permanent, and since there never has been sufficient evidence offered to show that this treatment is satisfactory, we must question the advisability of such methods, especially since a large number of failures are met with, and for the reasons already given.

As further evidence that this method cannot be satisfactorily applied, I wish to say that, in my experiments conducted on dogs, to determine the results of pulpectomy, it was found that the remaining portion of the pulp invariably degener-

ated, with evidence of periapical infection.

I do not believe that we should do pulp capping promiscuously: we should select our cases with care. The cases that justify capping of exposed pulp are those in which the root end has not fully developed. In these cases, it is doubtful that a successful root canal operation could be performed, owing to the large size of the foramen. I believe, therefore, that pulp capping would be justifiable provided favorable conditions exist; that is, when putrefaction of the pulp has not taken place to any great extent.

If vitality of the pulps of such teeth can be retained for a time, permitting the development of the root end, a most valuable service will be rendered. After this stage of development has been reached, the pulp can be removed, a root canal operation giving reasonable assurance of success.

Pulp capping should never be regarded as a treatment assuring permanent results.

Owing to the difficulty of making a diagnosis in most cases, especially if decomposition has taken place, it cannot be expected that any method will be successful in retaining vitality in all the treated cases.

The requirements of this method should be to retain vitality of the pulp. To retain vitality it is necessary to prevent decomposition, and this can be accomplished only by sealing in a remedy that will control the activity of bacteria. I question that it would be possible to sterilize the dentin to prevent decomposition by such means.

It should not be necessary to state that the rubber dam must always be applied and the same care used that is required for successful work in other branches of dentistry.

I can see no objection to leaving a layer of decayed dentin over the pulp.

By my method, a stiff paste is made by mixing the powder of a cement and the liquid hydrated chloral. This liquid is prepared by triturating equal parts of hydrated chloral and thymol in a warm mortar, which causes them to liquefy. A small portion of this paste is placed directly over the pulp, after the softened area of decay has been removed, and the cavity thoroughly dried, and the pulp is covered with white copper cement, as this seems to be less irritating than most cements.

The results of work done by Elmer S. Best are apparently proving satisfactory. While he does not approve of pulp capping as this is generally understood, he has worked out an operation for preserving the vitality of the pulp which, in his hands, has proved very satisfactory. He proceeds as follows: With the rubber dam adjusted, all the softened dentin possible is cautiously removed without actually exposing the pulp. The cavity is thoroughly irrigated with a warm surgical solution of chlorinated soda, dried and an antiseptic applied to the base of the cavity immediately overlying the pulp. This is covered with oxychlorid of zinc cement and the cavity filled with oxyphosphate cement.

Vitality tests of the pulp in these treated cases should be made frequently, and roentgenograms should be made occasionally to determine whether the root end is developing.

The question naturally arises as to what should be done with teeth having exposed pulps not suitable for capping. My answer to this question is: Remove the pulp and fill the canal. While claims are made by eminent investigators that all pulpless teeth are infectious, proof to substantiate these assertions is still lack-

ing. It is true that the technic used by these investigators does succeed in obtaining a growth of streptococcus from these roots, but I wish to call your attention to the error in this technic. Before doing so, I should like to have you gain a clear conception of the structural make-up of the teeth. I realize that it is preposterous for me to dwell on this simple matter,but it is important that one have a proper conception of the anatomy of the teeth in order to comprehend the point that I wish to emphasize.

The outer covering of the root, cementum, is an impervious structure. The dentin, as you all know, is a tubular structure. It should be remembered that there is no relationship between the dentin and the cementum. Bacteria cannot pass from the dentin into the cementum; therefore, it is possible to have infected dentin without having the organism pass through the cementum into the blood stream, where the foramen is hermetically sealed. If the organisms do not reach the outer surface of the root, how can such a tooth be infectious? In the method used in obtaining cultures for these experiments, the end of the roots are snipped off and dropped in the medium. These root ends have dentin as well as cementum, and naturally if the dentin is infected, a growth would be obtained. These results do not prove that the bacteria are in the cementum as the reports of these experiments imply.

As further proof that pulpless teeth are not all infected, I wish to state that a large percentage of the teeth showing no roentgenographic evidence of infection will, if examined microscopically, be found to be free from infection of the periapical tissue.

The fact that cementum is laid down in the foramen of teeth after the pulps are removed proves that infection does not follow immediately, for cementum could not be formed in the presence of infection. This fact also refutes the theory that infection is a result of lowered resistance produced by pulp removal. There is every reason to believe that the tissue formed in this process of healing affords a most satisfactory repair. There is no reason to assume that infection will occur in the membrane that is in contact with the newly formed cementum in the foramen. There would be just as much reason to believe infection would result in the tissue lying in contact with the cementum on other parts of the root, since the same pericemental membrane covers the entire root. The cementum receives its nutrition from the membrane, and it must be remembered that removing the pulp has no effect on the membrane or cementum. The cementum formed in the foramen is no more susceptible to infection than cementum formed on other parts of the root. A pulpless tooth is not a dead tooth, as is so often implied by some investigators.

The profession is rapidly coming to realize that the mere removal of the pulp is not responsible for periapical infection, and the fact that some pulpless teeth are not infected disapproves such a theory.

The absence of the pulp or the fact that a tooth is pulpless is not the cause of periapical infection, but this condition makes infection of the investing tissue possible, owing to bacterial invasion. Time will not permit a discussion of the various means of bacterial invasion, but I do wish to say that the transportation of these organisms can often be prevented, and thus periapical infection can be avoided.

The question now naturally arises as to the causes of periapical infection. There are a number of reasons for the

development of this condition, and dentists are responsible for a large percentage of these cases of infection. Many teeth become infected in the treatment, or at least during the root canal operation, owing to lack of asepsis and a total disregard for the welfare of periapical tissue; in other words, because of injury of the periapical tissue during the operation.

The tissue should never be removed beyond the dentinocemental junction. Absolute asepsis must be observed at all times during the operation. More than a decade ago, I called attention to the fact that if the tissue was removed only to the dentinocemental junction, cementum would form to close the foramen, and this work has since been corroborated by many investigators.

The most important part of the root canal operation is hermetic sealing of the apical portion of the canal. There are perhaps only a small percentage of teeth treated which do not have infected dentin previous to treatment owing to decomposition of the pulp tissue. If the canal is not perfectly sealed, bacteria will escape from the infected dentin into the periapical tissue, infection resulting. This fact does not seem to be generally recognized by the dental profession. It can readily be seen that if space exists, bacteria will surely find its way to the tissue at the apex, through the nutritive liquids which diffuse into such spaces, from the periapical tissue. Laboratory experiments have also proved that it is possible for diffusion to take place through ill-fitting crowns and fillings. This would be another means of nutrition reaching bacteria in the dentin.

One of the important problems before the dental profession today is to decide on a technic that will be known to seal canals hermetically.

The first requisite of such a method is that the root canal material used must possess the essential physical properties: the material must be impermeable. Laboratory experiments conducted have proved that many of the materials offered the profession do not fulfil these requirements, because of their permeability. Diffusion will take place through such root filling furnishing nutrition for the bacteria present in the dentin, and also furnishing an avenue for their escape to the periapical tissue. These experiments also showed that diffusion may sometimes take place through secondary dentin existing in the root canal. Therefore, I believe it is very important that all of the secondary dentin be removed before the root is filled.

The difficulty with the methods now used is that one does not know that the apical portion of the canal is hermetically sealed. While the roentgenogram may show that the root is filled to the desired point, it does not show that the diameter of the cone is sufficient to fill the entire canal; in other words, the cone used may be long enough, but smaller in diameter at the apex than the canal, leaving space for the escape of bacteria.

The only practical method would be to standardize the cones in diameter as well as in length as to the reamers to be employed, using roentgenograms to determine when the desired apical point is reached by the reamer establishing a shoulder in the pulp chamber for measuring to the apex. Such a method would assure a complete sealing of the entire canal, preventing the possibility of bacteria escaping from the infected dentin to the periapical tissue.

The cones would need to be sufficiently rigid to prevent distortion. I have found gold cones very satisfactory.

It does not seem right that all pulpless teeth should continue to be extracted, as is being done in some sections, merely because the average general practitioner is not inclined to acquire the necessary skill to do this work satisfactorily.

A large percentage of pulpless teeth become infected because the operation is not properly done, and not because of the impossibility of doing the work properly, and it seems to me that an effort should be made to correct this situation.

PRESENT TREND OF THE PRACTICE OF ORTHODONTIA*

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THE subject which has been assigned to me is no new one. An examination of orthodontic literature of the past fifteen years discloses many contributions dealing with the same theme. Careful perusal of these writings further discloses the fact that they are more or less in the nature of personal reflections anent a very interesting subject, namely, the life work of the individual, than which nothing can be more engrossing. The chief value of all such contributions to professional literature lies in the disclosure of the individual's point of view in relation to his problem; likewise, a general treatment of the subject is often liable to be approached from an angle of personal prejudice. A request for a paper of this kind is usually engendered from a desire to refresh our minds on and elicit discussion of some of the relationships with which the practice of orthodontia is bringing us increasingly into contact. It is on a few of these relationships that I wish to dwell for a time and, as in the case of my predecessors, my remarks will consist of my own personal observations over a period of eighteen years, but I shall not expect you to accept as true nor do I expect all of you to agree with what might be termed merely postulations on my part.

It was not so long ago that the practice of orthodontia as a specialty was considered largely an experiment. General dentistry was already well entrenched, and it required courage of no small order to back one's vision of the true worth of our specialty by cutting away from the security of the general practice of dentistry. Those first few years were hard years for the pioneers, on whose soundness of judgment so much of our later success depended. The zeal of the true pioneer must have carried them through this trying period, until the very fire of their enthusiasm incited others to join the ranks in constantly increasing numbers. Certain it is that the number of specialists in orthodontia is rapidly increasing, and this brings us to our first major consideration.

I shall try to develop this particular theme by dividing it into several minor parts, the first of which deals with the increasing popularity of orthodontia *per se*.

A few years ago, the orthodontic problem held practically no place in the programs of organized dentistry. Its appearance was a gradual evolution, its earlier recognition being perhaps due to the activities of the American Society of

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Orthodontists. Then followed the organization of the Section on Orthodontia in the American Dental Association, and this group has consistently developed its influence in that body. From this point, we note an increasing number of orthodontic contributions to the programs of state and district dental organizations, and more recently we find that, in several instances, orthodontia has occupied the most prominent position in such programs. This direction of attention to a single specialty could have no other effect than the recruiting of more and more devotees to its practice, and the necessity for adequate instruction here made itself apparent. The result was the genesis of the proprietary school, the apprentice system by individuals, and attempted instruction by dental colleges. From these sources have emanated most of our specialists today. This educational problem is the gravest one before us at the present time, and apparently it is still far from solution. We shall refer to it again.

Synchronously with the manifestation of increased interest in orthodontia by general dentistry has developed an awakening on the part of the public to the advantages of this type of dental service, and this fact has, in my opinion, changed the complexion of the orthodontic situation in no small degree. Under this stimulus, the status of orthodontia is rapidly changing from that of a highly isolated specialty to one of much more common practice, and this situation presents many angles of serious character. It is one thing to stimulate a demand and another thing to supply it adequately. Inadequately supplied, the demand will languish, and it may, in its demise, tear down some of the pillars which our pioneers have so arduously erected. To clarify this point, let us make it more specific. The practitioner of general dentistry under the constant and ever-increasing accentuation of the orthodontic phase of modern dentistry has begun to consider it in relation to his every-day practice—his livelihood, if you will. What is the result? He must begin to recognize the cases of malocclusion which occur among his patients or his patients will recognize them for themselves. In either event, the dentist must be considered as the means through which correction of the existing deformity must be effected. Right here the problem becomes personal in its character, and the dentist must determine whether he shall treat the case or refer the patient to someone well qualified to care for it. The latter alternative is not always easily accomplished, particularly in small urban and rural communities, and this is an angle to the problem of the practice of orthodontia which is not always considered by most of us who practice as specialists in large centers. That it has its significance is becoming more apparent year by year, for many of us who are situated in centers serving somewhat of a rural community are discovering in our practices many more patients from smaller towns than formerly. We are also observing more cases which have been mishandled in attempted treatment by well-meaning dentists who have lacked perhaps the judgment and skill of long experience. Such instances precipitate situations calling for the exercise of considerable tact and judgment on the part of the specialist.

The entrance into the field of orthodontia by the general practitioner more generally has given rise to the development of what we may term systems of "long-range" diagnosis and treatment. Before we yield to our natural impulses as specialists and universally decry all the

efforts which are being made to help solve the problem of orthodontia for the man in small communities, let us rather analyze them. Unfortunately, today, our own specialty is divided into groups themselves more or less divided in their opinions as to proper diagnosis and treatment, and, we are led to believe, well-meaning and meritorious efforts by one group are frequently ridiculed and denounced by another. Careful examination of any system of orthodontics as practiced by any of us would reveal that any of them as yet is far from perfect. We are all prone, nevertheless, to dwell largely on our successes and not too freely admit our failures. Orthodontia as it is practiced in our own ranks is far from ideal, and we as specialists still have much to learn of tolerance for the opinions of others and respect for the great field in which we are striving. I am of the opinion that there are several ways of doing the same thing, but when I say the "same thing," I do not mean something else. Our great difficulty today lies in the fact that when we as individuals, after long and arduous study and intensive work, have mastered to a degree satisfactory to ourselves certain phases of our work, we seem to conclude arbitrarily that the same end can be reached in no other manner. In other words, we conclude that we are no longer "green," but it is pertinent to observe in this connection that only while one is "green" does he grow.

If we approach the subject of the "long-range" diagnostician and appliance maker's advent into the field of orthodontia with a bit of toleration and in somewhat of an analytic frame of mind, we will readily discover several things. First of all, we shall have to admit that this departure from orthodox orthodontia has developed, in some degree, to meet a demand, and also, in some instances, it has been developed to create a demand. For the former motice, I must concede that I have some sympathy; for the latter, I have none. I believe that there are institutions which honestly consider that their assistance in helping the dentist to solve his orthodontic problems is a part of their service to their clients. It is barely possible that they may be filling a gap which our dental educational system has left open. There are, on the other hand, institutions which daily seek to exploit a particular appliance and to educate the dentist to a belief that only in a certain mechanical appliance lies the secret to the solution of all orthodontic problems and the open sesame to the road to fame and fortune. Such an attitude smacks of all the arbitrary intolerance which usually fills the orbit of those engaged in the exploitation of any human ailment for their own commercial ends. Mere castigation and denouncement of these enterprises will never benefit the public which we are supposed to serve. Rather, it is going to require a consistent dental educational policy founded upon the basic principles of orthodontic procedure which have been evolved through years of thorough trial, and which have been universally accredited as being most nearly fundamental. A graduate from a dental college whose curriculum embraced sufficient orthodontic education to enable him to, at least, start his orthodontic thinking from an original premise of fundamental truth would make a poor customer for the wares of the commercial appliance purveyor.

No one who has practiced orthodontia for any length of time can fail to realize that a knowledge of certain mechanical principles does not comprise the full equipment necessary to cope successfully

with all orthodontic problems. I was almost going to say that, as we grow older in our chosen work, mechanics becomes less and less important in view of the many deeper and larger factors which seem to enter into our conception of our work. To one, however, who has not yet passed through the sometimes humiliating period of experience upon which judgment is founded, the mechanical appliance temptingly presented as a quick means to a quick end possesses apparently much allure. In time, the conscientious orthodontist will painstakingly but surely develop a technic which will carry him through the detail of his work, and his mind then will be more free to engross itself with other and more fundamental problems. I would like to admonish the younger men in our profession to guard against imperiling their professional success by too implicit confidence in mechanical wares, designed many miles from their patients, and created on plaster-of-Paris models by someone who assumes none of the responsibility of the discharge of professional duty upon which the dentist's individual success is fundamentally builded. The orthodontist should be the diagnostician of his own problems; he, and he alone, has access to the symptomatology in specific instances, and it is his prerogative and his duty to prescribe his treatment. If, after such careful diagnosis, he believes that it is best to have another carry out his ideas in the mechanical construction of his prescribed appliances, he may find it expedient so to do. A consistent policy of the subordination of all other factors in favor of "long-range" diagnosis and mere appliance construction, in my opinion, points the way to ultimate dissatisfaction of the orthodontist in his work, which may be equally shared by the public he serves. Orthodontia, in line with every branch of health service, demands the deep, personal application of its practitioners, in whom it must instill a professional consciousness which will place it increasingly higher in the plane of personal service.

Synchronously again with the increased interest of the profession in the practice of orthodontia has arisen the development of the extension of its benefits to the so-called masses. We are all aware of the criticism which has frequently been directed at us, of being servants of the fortunate few to the disregard of the many. Unjust though many of us may believe this accusation to be, it nevertheless must be considered in this day of social service. If orthodontia is truly a branch of the healing art, it has undoubtedly a duty to perform in this direction. We may be willing to concede this point, but there are several difficulties which seem to handicap the successful resolution of the problem. Foremost among these is the nature of the work itself. Successful treatment of malocclusion is predicated upon closely governed assistance to developmental processes which are gradual in their function. The successful maintenance of corrected occlusal balance accompanied by all of the corollary indirect tissue changes requires an extreme nicety of adjustment. Nor can this readjustment of tissue be unduly hastened. Furthermore, it is no uncommon occurrence for cases to resolve themselves unsuccessfully after long, arduous treatment by even our most skilled operators. The majority of our simpler cases require many months of treatment and supervision before we can declare them to be successfully treated, and if there were available accurate records of actual time consumed in the treatment of many cases in practice, they would unquestionably reveal how individual or-

thodontic treatment must be. In practically every other branch of medicine, as it is today being administered through social service agencies to the so-called masses, infinitely less time is devoted to the individual, with the possible exception of some phases of orthopedic surgery. This fact in itself militates strongly against ever producing mass administration of orthodontic benefits, if we administer treatment with an aim to the perfection of result which our experience up to date seems to indicate as being absolutely essential to permanency of benefit. It has been affirmed that much of good may be accomplished and great benefits rendered the thousands of children suffering from major malocclusion if partial treatment only is accorded them within the limits of public economy, and this view may withstand considerable negative argument. If we allow our point of view to be influenced by our own personal experience in practice, it would seem evident that incomplete orthodontic treatment would be of questionable value to the recipient. This charitable administration of orthodontia to the needy in any community is on quite a different footing from its administration in the clinic of a dental college. In the first instance, the accent is upon the patient; while, in the latter instance, the accent is upon the student seeking to equip himself in a state institution. In the dental department of the Minneapolis General Hospital, an orthodontic department is conducted to which patients are referred through various social welfare organizations. While many children are being benefited thereby, it is undeniably evident that the number is pitifully small compared with the vast number of those requiring orthodontic treatment. It is also being conclusively demonstrated that this mere handful is receiving care which may well be defined as disproportionate when compared with other health services. If it is argued that the value of the orthodontic services rendered is not disproportionate to the effort expended, surely half-way measures of treatment cannot be presupposed. And my own conviction is that, when the ultimate in treatment is expended on any one case in such an institution, orthodontia becomes really valuable to an insignificant number of the masses. The only remedy, then, which we may even hope to evolve as being most far-reaching in its effects is based upon preventive lines, and, like other phases of dentistry, repair will always stare us in the face until we reach the utopia of universal elimination of physical defects. In spite of the apparent insurmountability of the problem at the present time, the demand for orthodontia is constantly increasing from this source, and we as orthodontists will some day be asked to effect a solution. The practice of the orthodontia of tomorrow will be involved in this phase of health service.

Notwithstanding the differences of opinion on many orthodontic points which are today prevalent in our ranks, the practice of orthodontia today is in a much healthier condition than ever before. It seems that we are becoming more analytic every day. The years are milestones marking our passage through the period of unbalanced enthusiasm into an era of saner introspection. It is gratifying to observe how our specialty has applied to itself every new facility which science has evolved for our assistance. There has been no standstill. The years have also brought home to us truths which time alone can effect, and one finds more and more contributions in our literature which have to do with frank discussions of our shortcomings. The practice of orthodontia has passed from a

spectacular fad into the field of recognized health service. Our relationship with allied branches of medicine is becoming constantly closer, and our responsibility as practitioners is increasing correspondingly. It is in the failure to live up to this growing responsibility that I believe our greatest danger as a specialty lies today, and it becomes evident that educational inspiration must be supplied our embryonic orthodontists in dental colleges if we are to succeed in developing these newer relationships. Whether the solution lies in reorganized undergraduate instruction or in postgraduate training is a moot question, but both of these channels merit our deepest study. Whatever educational scheme is finally evolved as being most nearly perfect, I am convinced that in it there should be no taint of intolerance. Orthodontia as an art and science is bigger than any one man or method, and while differences of opinion will always exist among individuals, there surely is a sufficiently broad foundation of unbiased pedagogic value upon which orthodontic training may be instituted. That dentistry and our dental colleges are already eager to seize on any solution of the orthodontic educational dilemma is evidenced by the responses made to any overtures in this direction. At Minnesota, a recently organized postgraduate course instantly became so popular that fully twice as many applicants for the training were turned away for lack of facilities as were admitted to the course. In summing up my observations on this point, I reiterate a statement made in a paper some time ago: "In orthodontia today . . . the spirit of intolerance is as prevalent . . . as in other branches of dentistry. Any theory or method which has value is not going to depend for its success upon active antagonism to all thought not in accord with it. Time and results will establish its worth. Let us rather welcome earnest investigation into all new thought in the hope that ultimate evaluation may differentiate the right from the wrong."

General dentistry's newer conception of occlusion in relation to the entire fabric of dental ills is bringing about a great change in orthodontic practice, and has offered a large opportunity to the orthodontist for fuller cooperation with his brother dentist. The benefits are mutual, for the application of orthodontia to general practice has brought to orthodontia a fuller conception of the significance of its own problems. B. Frank Gray's recent symposium based upon his questionnaire, which elicited replies from many outstanding orthodontists, brings up this point excellently. A few years ago, orthodontists were apparently too well satisfied to delve along in their own tunnel to even contemplate the realm outside. Now it becomes apparent that we need the help which other contacts admirably supply. This is an incontrovertible evidence of the trend of our development in practice. While there may be some of us who will cling to the isolation of an earlier day, the successful orthodontist of the future will be the man of larger professional interest who will visualize his problem from all of the angles of physical diagnosis which contemporary science can provide. This type of orthodontist will bring about more unity in therapy, greater understanding between individuals and a broader educational facility for those seeking to enter our special field of practice.

You are all familiar with the old story of Sir Christopher Wren, the great English architect, who, unrecognized by the workmen, one day wandered into a large cathedral which he was building. He

stopped one of the stone workers and said: "What are you doing, young man?" The worker replied: "I am trying to make this cursed stone fit this hole!" Passing along he put the same inquiry to a second workman, who replied: "I am working ten hours a day for five shillings." After a little, he said to a third workman, "And what are you doing here?" The stone-cutter put down his hammer and chisel and, looking up to the sky, he answered, "I am helping Sir Christopher Wren to build the greatest cathedral in all England." In conclusion, I should like to paraphrase this anecdote and let us imagine that the Great Spirit of our chosen profession entered our offices today. To his first query, he might receive the reply: "I am trying to fit this cursed appliance to these misshapen teeth!" The second workman, on being questioned, might reply: "I am trying to make all the money I can out of this practice, regardless!" And when the third worker was asked, "And what are you doing here?" I like to imagine him replying, "I am trying to further ennoble a great profession by helping make this little child a more beautiful and useful human being."

DISCUSSION

R. C. Willett, Peoria, Ill.: Dr. De Vries' paper deals with a subject pertaining to the growth of the profession of orthodontia, and the extension, through more scientific methods, of the benefits of orthodontic treatment in localities remote from large centers of population. From the date of my earliest association with teachers of orthodontia (which was about twenty-eight or twenty-nine years ago) down to the present time, the matter of orthodontic education has been a much discussed problem, and, to quote Dr. De Vries, "Careful examination of any system of orthodontia as practiced by any of us would reveal that any of them as yet is far from perfect." My discussion of the paper will be based, as were the essayist's conclusions, largely upon personal experience, and therefore may be biased by "personal prejudice"; but the cold fact is that the individual's successes and failures in any line of work remain his most valuable assets, although the experiences of his fellow workers may also count as deterrent or incentive factors. In the early years of my experience in the practice of orthodontia, because of the character of my location I very soon came to a realization of the difficult situation that confronts the conscientious dentist in outlying small communities, when he is obliged to consider orthodontic treatment for the child patient coming under his care. Believing it to be my duty to help such practitioners to solve this problem by extending to their patients the benefit of an equipped orthodontic service, and also because I needed the practice as a means of paying office expenses and other items necessary to a livelihood, I undertook the carrying out of a plan by which I hoped to relieve the correlated situation. The plan was first suggested by my friends among the dentists. I informed the dentists of my acquaintance who were distributed over an area extending for about 50 miles from Peoria that I would undertake the treatment of patients "cooperatively;" that I would diagnose the cases, outline the treatment for each, set appliances, personally inspect the progress of the treatment at regular intervals, and, further, that I would, through correspondence, direct them in the carrying on of their part of the work. The fee arrangement was that the patient paid me for the service which I rendered, and the dentist was paid whatever he saw fit to charge, although we usually conferred in regard to the amount of his fee. There was, in no case, any exchange of money between the dentist and myself. The outcome of this experiment was that I had patients galore and experience in plenty. Results varied according to the character of the case and that of the dentist at the other end of the line. With a few dentists, the plan worked out satisfactorily, but with the majority, it did not. I completed, to the best of my ability, the treatment of the many cases, and then avoided any further arrangements for orthodontic cooperative work. The experience, though very expensive, taught me some valuable truths, one of which was the limitations of the general practitioner when he came to orthodontic problems without clinical experience regarding them; and another,

that orthodontic treatment can be carried on successfully with less frequent visits from the patient than many orthodontists believe necessary for the attainment of creditable results. That early experiment also developed a resourcefulness that has proved to be a great asset in the management and treatment of many patients living at a distance, and who are not seen for the adjustment of the appliance oftener than at intervals of from four to six weeks. While such methods of practice may not be feasible or even desirable in all cases, I am certain that they are productive of better treatment than many patients could otherwise receive. Two distinct advantages are gained: Such practice extends the benefits of orthodontia to remote localities, and the less frequent visits of the patient give to the orthodontist the time and opportunity to serve more patients than he otherwise could. It also affords him more leisure in which to study carefully and plan the treatment of each case, than would be available if his office were continuously filled with patients waiting for the adjustment of appliances. It is denied by some that the orthodontist needs experience in the general practice of dentistry, but I am convinced that the average orthodontist would profit much by spending some years in such practice. One certain result would be that his sympathy for the dentist who is striving to gain a comprehensive knowledge of orthodontia would be keener. The ever-increasing demand for the services of specialists in every branch of the healing arts makes it not only right but also necessary that the present-day practitioner of dentistry shall know the fundamentals of orthodontic diagnosis and prognosis, and be familiar with certain technical phases of conducting orthodontic treatment. He should know these things in order that he may intelligently use preventive measures against the occurrence of malocclusion, as the physician employs preventive measures in safeguarding his patients against ills which, once incurred, would eventually require the services of a specialist. Armed with this knowledge, in the event that orthodontic service is required, the dentist will be able to determine for himself the qualifications of the specialist to whom his patient is directed. Surely this knowledge is of no less importance to the conscientious dentist than to the patient whom he consigns to the care of the specialist. Unless the dentist in general practice absolutely excludes the child patient, he cannot, with honesty, excuse himself from the acquisition of a certain amount of knowledge pertaining to the causes of oral deformities and the detection of incipient stages of malocclusion. As a matter of "livelihood," I do not believe that the practice of orthodontia by dentists generally needs to be discussed, because the orthodontic specialist can conduct treatment more economically than the conscientious dentist in general practice who is neither fully equipped, nor prepared through special training and experience, to carry on orthodontic work. This fact has been conclusively established to the full satisfaction of many conscientious dentists who have attempted orthodontic practice in connection with their general practice. With few exceptions, they have eventually given up one or the other. The matter of social service in my professional line has received my serious consideration, and I have attempted, through many different plans, to carry the benefits of orthodontic treatment in my own locality to at least a few who were unable to pay for services of that kind. With few exceptions, such attempts have been dismal failures, partly because of a lack of continued interest on the part of those who should have been sufficiently interested to keep the patient in touch with me until the objective was accomplished, and partly because of the matter of nutrition and the personal care of the patient necessary in meeting the requirements of successful orthodontic treatment. I shall certainly welcome the day when two orthodontic problems shall have been solved: that of efficient service in small communities remote from large centers of population, and the social service problem. There is a field of work that is well within the scope of general practice and which remains practically untouched: the field of children's dentistry. It lies on the borderline of orthodontia, and it should be receiving more serious attention from the general practitioners in the profession. I wonder whether those men of Minnesota who are storming the doors of the University for instruction in elementary orthodontia have mastered the art of practice in this all-important and interesting branch of the profession or whether they have left this work undone while endeavoring to undertake the deeper problems of orthodontia. Have they made a careful study of methods of cavity preparation applicable to deciduous molars, by which methods restorations can

be placed that will permanently restore function and tooth form throughout the period of their use, without endangering the pulp? Have these men mastered the technic of protecting unoccupied spaces in the deciduous arch which have been left through the premature loss of deciduous molars, thus placing a check on mesial and distal migration of permanent teeth, as well as on many other ill-effects that follow the premature loss of deciduous molars? If this has been accomplished in the private practice of these men, they have helped to fill a yawning gap in dental service and, in the process of their serving, have done more for the prevention of malocclusion than many orthodontists accomplish in its correction.

MOTTLED ENAMEL

By CARL FOSSUM, D.D.S., Aberdeen, S. D.

MOTTLED enamel in its various macroscopic forms and tints no doubt antedates history, yet little progress has been made towards combating this annoying condition up to the present time.

I wish to present some new ideas for consideration, as a result of years of observation in this community, known as an endemic area. I trust that they may in a measure stimulate further investigation dealing with this sad state of affairs.

My ideas may differ somewhat from the accepted general line of thought, yet I believe that I am justified in making the following statements.

In choosing a subject for consideration, we like to be guided, to a considerable extent, by requests that come to us from our patients, and judging from the number received relative to mottled teeth, we may rest assured that we as dentists should devote considerable time and study and prepare ourselves to meet this deplorable situation.

This disease known as mottled enamel, brown stain, or streaking of the enamel, of both deciduous and permanent teeth, particularly permanent, is one which, so far, exists in defiance of either the dental or the medical profession.

Many years ago, when I began practicing, I was annoyed in finding so many patients with pitted enamel, and being unable to meet the situation, I naturally wondered why I had not received instructions at college dealing with this condition. I remembered studying the so-called Hutchinson teeth, but this did not explain the situation at all. In my dilemma, I therefore sought all available information through current literature, both dental and medical, and also through the aid of research laboratories, and the scarcity of information easily explained why the college offered so little on this subject.

I thought that if I could find its cause, I might produce a remedy, but it seemed that this was not to be. In 1910, while in charge of the program of the dental clinic here, I made an attempt to get papers on this matter, by both dentists and physicians. The subject was, "The Deleterious Effects of Skin Diseases upon the Development of Teeth During the Period of Eruption." The papers were good, but the subject assigned was evaded because there seemed

to be little to say aside from its appearance.

Being forcibly impressed with the fact that little was known relative to this disease and that my findings, as substantiated by case histories, were new, I naturally took a keener interest in the subject, and the more I investigated, or rather observed, the facts at my disposal, the more I was certain that I was right.

Many years ago, our Society entertained a prominent dentist from Colorado who presented this subject, and I believe that he attributed these conditions to malnutrition, artesian water and heredity, but principally to artesian water. Years ago, Hutchinson first called attention to malformation of the anterior teeth, particularly the incisors, and ascribed this to congenital syphilis, or hereditary causes. He says, "It has been noted that not all children who are victims of hereditary syphilis present these dental appearances, and again, appearances said to be identical with them are observed in children said not to be syphilitic." It seemed a little confusing, but threw some light on the subject.

Located as we are in the heart of a so-called endemic area, everything gets its share of blame, from artesian water to lack of moisture in the air, and as a consequence, much confusion exists. One feels that something should be done; for how often we see an otherwise beautiful set of teeth marred by this mottled discoloration and the life of the individual seriously handicapped thereby.

Many authors claim that this disease is prevalent in certain regions more than others, notably in Texas, Virginia, South and North Dakota, California and Oregon, also in the Bahamas and Cape Verde Islands, and in many other places as well. Sometimes, this disease appears under a different name, such as brown or black stained teeth, notably in Italy and Asiatic countries, but the endemic areas are the same and fully as important.

Black, McKay and others who have made investigations have found that a percentage as high as 87.5 per cent of the inhabitants who are native born are affected in these areas. Bampton, in 1914, described two cases of brown pigment and pitted teeth and said that the condition was seen in the deciduous and the permanent dentition and that these cases were hereditary. (This seems to be a positive statement.) Black, who began investigation in 1908, states that the dark brown spots or streaks usually occur in pigmentation or mottling of the incisors. He arrived at the conclusion that there was a failure of normally occurring cementum, between the enamel rods in the outer one-fourth to one-third of the surface of the enamel and the coloring matter takes the space of the normal cementing substance between the enamel rods. He further states that the more of this brown stain there is, the darker will be the color and the weaker the teeth; that Nasmyth's membrane is always normal, and the probable result is failure of proper development of the tissues. Dick thinks that the brown staining alluded to by Black is due to malnutrition and that, in an examination of school children, he found 40 per cent to be affected. Black found the brown pigment to be coincidental with freckles, but he asserted that this mottled condition was due to dystrophia or faulty nutrition. Grieves thinks that it is due to thyroid disturbances or at least to some defect in endocrine secretion. McKay, who has made the most thorough and extensive investigation of the disease, visiting nearly every affected area

in the United States, asserts that the damage is wrought by some influence which acts either in an inhibitory or in a destructive way on the enamel, during or immediately after the building period, and that the condition is established prior to eruption.

Two prominent Italian dentists who have written on the subject of mottled teeth come to the conclusion that there

Upper central incisor (from patient over 40 years of age), showing the effects of measles at 7½ years and chickenpox at 9 years; findings which were confirmed by the patient. The white effect of the enamel is not natural but the result of the engraving process. Except for the enamel blemishes, the tooth is perfect.

is a minimum content of normal salt in general and of the salts of calcium in particular. This minimal content of calcium salts is the cause of the condition which produces mottled teeth. McKay says further that whatever the cause is—if it is the water supply, which appears very probable—it has not as yet been discovered. Gies thinks the brown coloring may come from the blood, during the enamel-forming period.

Many of our local dentists have attributed the mottling of the teeth to our artesian water, to malnutrition and even to heredity. The schoolnurse, who follows a similar line of thought, from contact with the profession, informs the school children and their parents of this theory.

The situation is confusing and unsatisfactory, and the causes are numerous and varied, with no remedy available at this time. Various theories have been submitted in explanation of mottled teeth. The diet has been given as the cause, but malnutrition and the water used, especially if artesian water, seem to be the chief enemy. Again, some say that the condition may be due to a disturbance during the formative period. All these and more are suggested; but one thing we know: it affects practically all races alike, for I have seen it in the mouths of Indians and Negroes, as well as in the white race.

I am in no way associated with a research laboratory, but I have access to them as has any one, and while I have nothing original to offer, I do find, after carefully reviewing the situation and elaborating on the findings of others, that I can, with an encouraging degree of success, prove my conclusions with the facts at hand, and it is with this positive diagnostic sign and other signs at our disposal that I am able to determine the nature and apparent cause of mottled teeth.

If we know the etiology positively, we may be able to combat the disease, and especially so, if we succeed in learning the direct cause, for treatment then becomes only a matter of detail.

Let us review a little. What is the difference between the hard and soft tissues of the body? The difference is the calcification of the one and the noncalcification of the other. What is calcification? It is the impregnation, in a tissue, of calcium salts. Where do the calcium salts come from that produce this change? At this point, a mistake is often made in considering the embryology of these tissues. The calcium salts with which a soft tissue, any formative

tissue, is impregnated, must always come from organic sources. It is a law of nature that no animal organism can organize inorganic matter. From where, then, are the calcium salts with which the soft, formative tissue is impregnated obtained? They must come from organic sources, and therefore all the hard tissues always have their origin from organic sources. The lime salts cannot be taken into the body for building into the teeth or bones: nature must elaborate its own from the pabulum, the food which the animal takes in and which is digested. The calcium taken in with the oxygen and whatever else goes to form these lime salts must be derived from external sources and elaborated in the body. It is a law of the constructive system that it cannot take its own bricks ready-made, but must form and prepare them on the spot and build them in with the other tissues.

There are two ways in which the lime salts may be organized into the tissues. They may be impregnated in a formative matrix, infiltrated therein, which is usually cartilaginous in character. This formative matrix is the embryonal material into which the lime salts may be incorporated according to the law of their development. Or they may be organized through a membrane. It is this latter way that shells are formed, by a membrane having in connection with it certain cells whose function it is to organize the calcium salts and build them into hard structures.

If the body cannot organize inorganic matter, there is no use trying to cure by administering lime salts a disease which is the result of a lack of these salts. A cure can be effected only by stimulating the nutritive forces so that their function will be sufficiently active to do the work and elaborate the material which is to be built into tissues, and the vitamins may be the stimulating force that is needed; yet how often we see it attempted.

Lime salts may be held in solution in water or any inorganic medium, and if for any reason they are precipitated through the neutralization of the acid which holds them in solution, they will fall in an amorphous form, that is without organization; simply dropping down as separate particles without regularity, without structure. That is the condition obtained when the precipitation takes place in an inorganic material, or inorganic fluid. Let there be an organic fluid of albuminous or gelatinous character, or other organic matter holding the lime salts in the same way, and when they are precipitated, it is in a very different form. They change their whole character and method of their organization, becoming laminated; that is, they are super-imposed laminae of the partially organized lime salts, and cohesion binds them together.

In the teeth, calcification is within a cartilaginous matrix and not from a membrane. In this matrix the lime salts will be held in solution. It is an organic solution, and as already stated, when the lime salts are precipitated, it is always in an organized form or structure. The differentiation and growth of the tooth structure I am not attempting to dwell on, but I am trying to show that the tooth substance is the result of crystallization of lime salts, in the presence of an albuminous medium. There is no other way to obtain tooth structure than by crystallization, and the crystallization of an element or a compound is always the same for that particular substance or material. One will either get the crystal or nothing; there is no modification of it, when formed.

A snow crystal or ice crystal, as an example, is a naturally produced angular solid of definite form, whether it is formed in South Dakota or Florida; whether it is formed slowly or rapidly; and when formed, it is always the same in hardness, but may be of a different color or hue and macroscopic appearance, this depending on the solution and formative influences or tissues. The beautiful crystals of ice and snow, in their myriad forms, are always hexagonal in outline. You will get either the six sided crystal or nothing, regardless of whether it is zero or 40 degrees below. If for any reason the water cannot get room to accommodate its crystallization arrangement, even at 40 degrees below, it will not freeze, but will remain liquid. There is no midway or modification of this law of nature: we either get the predetermined crystallization of the substance or nothing, and if for any reason the crystal is altered, this must take place after it was formed.

Immediately after the crystallization of a substance, then, we must have a uniformity of arrangement and hardness. Alteration, or mutilation of an ice crystal, is brought about by heat, and tooth substance, which is the crystallization of lime salts in an albuminous medium, by an acid.

A tooth, then, which is the result of a crystallization, must either be developed microscopically structurally, or else not developed at all, and this, according to the laws of nature. Hence, there can be no part formation; but we can and do get varied shapes and colors. The modification of the tooth structure must take place after the tooth is formed, from some source foreign to its development, an outside influence.

The enamel, being completed before eruption, must then be perfect in structure prior to its entry into the oral cavity, and being about 98 per cent mineral matter, absolutely dead and fully formed before eruption, it stands to reason that anything one eats or drinks, or does, must act directly on it, or be passive to it, and in this respect about all that could happen is a surface discoloration.

This elaboration shows the folly of attributing destruction of the enamel, such as in mottled teeth, to hereditary causes, to prenatal influence, to malnutrition affecting formative disturbance and allied attributes. If, for any reason, there is still a doubt, the very fact that all teeth are not equally affected, with reference to the same enamel development, throughout the dentition, must confirm it. Furthermore, could any development or disturbance affect the one and not the other when they are equal dependents? I think not. In the process of elimination, then, we find that all teeth are created the same in hardness of structure, and the same in the arrangement of its formative structure; in other words, as we should find the crowns of all unerupted teeth practically the same in the foregoing respects, we must attribute the mottled tooth condition as something occurring from the eruptive period on.

The composition of a tooth chemically shows that the only thing which could cause the loss of tooth structure must be an acid, as only acid substances can dissolve it.

The enamel must play a passive part in the disease process, being cut off, at the completion of its formation, from all sources of nutrition, besides being deprived of all defensive mechanism against agencies which may threaten its destruction. As it is nonvital, constructive or retrogressive metamorphosis cannot take place. As it is an inert chemical

substance, the acid destructive agencies are apart from the tooth itself.

Water, being neutral or alkaline, need not even be considered, notwithstanding the artesian water "scare." As further proof of the fallacy of this theory, I have a tooth which has been immersed in renewed artesian water weekly for about fifteen years, and, if anything, it looks much better than teeth I have had laying about in boxes for a similar period of time. The food theory must be abandoned because (1) the agency must be an acid; (2) all teeth would be affected; (3) all teeth would be affected on all surfaces, and (4) the phenomena would always be the same. Again, it would no doubt be more or less prevalent in all families of a certain district and all members of the same family. So we find that water and food, and malnutrition during the formative period, and the preeruptive factors must all be classified as nonconducive to the cause of mottling of the enamel. Even oral prophylaxis must be a negative contributing factor, because only a few teeth may be affected, only one of several children may be afflicted, and adults are never affected. Hence, we must look elsewhere for the acid and acid cause or causes other than the tooth decay theory.

The fact that enamel mottling takes place in an individual tooth while an adjacent one is free from mottling defects proves it to be due to an acid secretion from the gums. The fact that it affects one tooth and not another proves that it mottled the tooth at the gum line during the period of eruption only. The fact that it did not affect all of the affected tooth shows that the acid destruction was of a certain duration only. The fact that all the teeth which were partly erupted were equally affected at the gum line at the time shows that the acid was general upon the gums in both jaws. The fact that the unerupted tooth, or even part of the unerupted, affected tooth, is free from destructive agencies shows that the acid was upon the gum surface only and not within the gum tissue. The fact that the portion of the erupted tooth extending beyond the gums and into the oral cavity remained unmottled shows that the acid was very attentive to the gum line only, and that the saliva may have been neutral or alkaline; and as the deciduous teeth are affected in a similar way, and no tooth mottling takes place after complete dentition, it is evident that the acid forming process manifests itself during the tooth eruptive period only, and that the permanent mottling disfigurement period must therefore be from 6 to 20 years of age, with the greatest damage period between the ages of 6 and 14.

I have on several occasions expressed an opinion as to the cause of mottled teeth to some of my local professional brethren, and as their findings are in accord with mine, I shall endeavor to give good and sufficient proof of my conclusions. I hope that much good will come of this discussion, and that the immediate future will give us the necessary preventive measures.

The normal mouth secretions are alkaline, but conditions can and do alter the situation. Any disturbance of the skin, throat, lungs, alimentary tract or any epithelial tissue area immediately causes acidosis. Acidosis is, according to research laboratories, one of the commonest conditions that are met with, resulting from any type of malnutrition, as a result of febrile disturbance; and this is manifested in the mouth, not through the salivary glands, but through what is known histologically as the mucous follicles, which are situated in the

gums, labiobuccally mostly, also on the inner side of lips, opposite the necks of the teeth. They are similar to the sebaceous glands of the skin, both being emphatically excretory and not secretory.

In a healthy mouth and skin, both are inactive and invisible to the naked eye; but just as night sweats are symptomatic of tuberculosis, so are the mucous follicles actively symptomatic, especially, of diseases accompanied by intermittent fever; in other words, the mucous follicles become pathologically active during an epithelial disturbance.

I have recognized hundreds of cases of intermittent fever by examining the teeth of the patients, regardless of the patient's age, at the time of the examination, and the proof of my conclusions were usually verified by the case history.

One is not only able to recognize the kind of disease which brought about the disturbance, but is able also to tell, within a few months, how old the patient was, when he or she had the disease, and, furthermore, what other diseases he or she has had, and the patient's age, within a few months, according to the case history. And not only that, but one can soon tell about how long the disease lasted. For instance, a girl, aged 20 years, who came to me, had some badly disfigured teeth, the condition being due to measles, chickenpox and some other condition which I was not so sure of; but I was sure that the last mentioned condition took place between the years of 11 and 13, and caused illness. When I so stated this to the patient, she told me that she had had the influenza or some similar illness during that period, because she was just able to be about for two years, commencing at the time that she was 11. I was able to tell exactly how old she was when she had the other two diseases, and also what the diseases were, and my statements were verified by both the young woman and her mother.

If a patient who is around 30 years of age has more or less pronounced mottling of the teeth, and we can say: "You had measles when you were 7 years old and scarlet fever when you were 11 years old," and then find that we are right, to within a few months. I believe that there is proof of a relationship.

I find that if I go over the different markings carefully, I can invariably tell, within a few months, when the patient was sick with the febrile disease, regardless of how long standing and regardless of its severity. I have diagnosed many a mild case, which was confirmed by the mother, only after reflection. She perhaps recalled that the child stayed out of school, because he was not feeling well, and possibly because of the mildness of the condition, the child escaped being quarantined for measles or whatever the disease was.

If mottling of the teeth is due to intermittent diseases, as I have tried to show, naturally one will find it among the whites, Indians, Negroes and all other races, in direct proportion to the race susceptibility toward these diseases and regional influence (endemic areas). This explains all the confusion referred to at the beginning of this paper.

With the history of a case, including the age of the child at the period of the disease, and an examination of the positions of the defects on the tooth, the age will serve as an indication as to whether there has been any connection between the eruptive fever and the mottling on the tooth. Further, if certain macroscopic peculiarities and colorings are always in evidence with relation to certain diseases, it is evident that the disease has brought them about. For

example, if pits have been caused by an eruptive fever, between the ages of 7 and 8, they should occupy the circular labial area, about half-way or midway between the incisal edge and the gum of the fully erupted upper central incisors; but if the disease occurred at the age of 6 years, or 6 years and 3 months, the permanent teeth are unharmed, with the exception of the occlusal surfaces, and a part of the gingival portion of all the first permanent molars. In other words, the pitting takes place at the gum line only, of all erupted teeth, and the pitting or mottling continues throughout the period of the disease; therefore, if a tooth erupted a quarter of an inch during this period, the mottling would spread over the enamel surface to that extent only and naturally would affect all erupting teeth, deciduous or permanent. It must be evident that the enamel already above the gum line, as well as below, could not be affected.

The general cause of the devastating diseases of a febrile nature that impair or alter the nutritional condition of the blood supply leaves an effect on the gum tissue primarily, because of the unusual capillary circulation. It is the longest capillary system in the body and has an unusual anastomosis as well; hence anything affecting the body nutrition leaves its imprint in this capillary circulation first. Defects in nutritional conditions, leaving their imprint on the gums, vary in their macroscopic appearance according to the nature of the disease, and if the disease lasts, a general body acidosis sooner or later makes its appearance. In the mouth, this acidity comes through the mucous follicles of the gums, which are found quite freely therein along the line of tooth eruption, buccolabially. This acid has a decalcifying effect on the enamel and I believe that this acid formation is the cause of tooth erosion in adult life, possibly through a siege of malnutrition brought on by autointoxication, or something of a similar nature. This acid formation, which has nothing to do with bacterial agencies, is simply the result of inefficient nutrition.

Malnutrition means suboxidation, and this manifestation is greatest in the capillary circulation of the gums. Suboxidation of course, accompanied by the retention of carbon dioxid in the cells, makes for acid reaction. Cell-waste is acid in reaction. We find, then, that accompanying an intermittent disease we have destruction, or mottling of the enamel, at the gum line, opposite the orifices of the mucus glands, and this affects all erupting teeth alike, at that time, regardless of whether they are deciduous or permanent, and whether the possessor is white or black, or whether its owner lives in the region of the artesian basin or not.

Now how can we tell whether the patient has had measles, typhoid fever or a bad case of tonsilitis, etc.? This can be detected by the macroscopic enamel dissolution, combined with its pigmentation.

I have never been able to determine why the gum acid causes a pit in measles and leaves a yellow streak in whooping cough or a partially opaque streaked area in tonsilitis. No doubt, the gum-acid is altered by bacteria of a chromogenic and a nonchromogenic nature, which first changes the physical nature of the acid, allowing it to remain in the form of a droplet, on the one hand, and, on the other hand permitting it to flow freely around the tooth. These bacteria leave the tooth enamel bleached or showing varying shades of discoloration, usually of a yellowish hue, in the enamel dissolved base through the proteins or

organic matrix, largely by pyogenic organisms, giving off end-products as indol, a blue crystalline by-product, or skatol, another colored crystalline by-product.

It seems that, in gum acidity, the readily diffusible and alkaline salts, sodium phosphate, of the cells and the excess carbon dioxid, existing as carbonic acid, forms on reaction an acid (acid sodium phosphate), and, in all probability this is the acid which attacks the calcium salts of the enamel. At any rate, it has been demonstrated by Brubaker that a tooth immersed for a week in a solution of acid sodium phosphate, and daily subjected to brushing, did at the end of a week produce spots and grooves.

Treatment would seem to be indicated between 6 and 18 years of age, with particular attention between the years of 6 and 12. The remedy, aside from preventing the disease, would seem to be local and general in its scope; locally, for the neutralization of the gum-acid, and by tooth protection, such as a tooth acid resisting varnish, and the general treatment, aside from the regular prescribed course by the physician, should be an immediate attempt to check gum acidosis. I am not prepared to state how this should be accomplished but I do believe that it should be foremost in the remedial effort.

I firmly believe that electrotherapeutics will help solve the problem, because the body fluids are largely composed of water, and therefore contain oxygen and hydrogen; and, in the process of electrolysis, the former is electronegative and collects around the positive pole, and the latter toward the negative pole, and it is this affinity that gives the two poles an exactly opposite therapeutic effect. Oxygen is an acid maker; consequently, the tissues adjacent to the positive pole are rendered acid in reaction, and tissue destructive in character, yet sedative in nature. Hydrogen is an alkali maker, and therefore collects around the negative pole, and the tissues are rendered alkaline, in the immediate vicinity. This creates a condition of overstimulation, or irritation; but one can see the possibilities, as a remedial adjunct.

SUMMARY

Tooth mottling is due entirely to an acid produced by the mucous follicles, which are quite numerous from the center of the gum ridge line, labiobuccally, but less numerous lingually. Further, this acid is liberated at the gum margin, in modified form, according to the indirect cause, which seems to be a disease of the intermittent-fever type, a throat and lung affection or an alimentary disturbance, such as typhoid fever; in other words, any disturbance of the mucous membrane.

This acid formation, which seems to take place regardless of the severity of the disease continues throughout the period of disturbance. The affected surface of a tooth is in direct proportion to the duration of the disease, and the progress of its eruption within that space of time. It affects all teeth in the act of eruption from visibility on, and this regardless of whether the teeth are deciduous or permanent, whether its owner is white or black and whether the person was born in an endemic area or not.

The fact that a tooth has been affected by one febrile disease does not prevent it from being again affected by some other disease, of this nature; therefore, we may find one tooth giving the appearance of passing through several disease periods, while an adjacent one may reveal a different number, this depending upon whether or not it was ex-

posed to conditions in the oral cavity, for the same length of time or not.

Roughly speaking, measles displays a band of pits, chickenpox, a pale yellow band, whoopingcough, a darker yellow band, typhoid fever, a very dark yellow band, tonsillitis and sore throat, a faint broken white band; influenza, a less broken and a more decided white band; pneumonia, a plain white band; and so on. Remember this: A disease of a week's duration may leave only a very narrow line because the tooth did not erupt very much during that time; whereas, if a patient had more or less sore throat and tonsillitis, from 7 years of age on, say to 12, the whole of the upper central incisor would be more or less covered on its labial surface, with white parallel streaks, more or less broken. If the child were 6½ years of age, and if this child's teeth were erupting at the accepted standard, normal time, and he had an average case of measles and then came to you when he was 20, you would find, all of the surface of the first permanent molars, on the occlusal and about one-sixteenth to one-quarter inch toward the gingival margin, badly pitted, as if some volcanic disturbance had taken place, and naturally the lower teeth would be a little more affected, because the eruption of the lower precedes that of the upper teeth. A typhoid fever band is usually about a quarter of an inch wide, owing to the length of its duration, which allows more time for the tooth to erupt; but of course all typhoid cases do not cause yellow banding of the teeth, as the fever and the eruption must be in unison.

I hope that good may develop from my efforts and that further investigation may be stimulated along this line, as I believe that the remedy is near at hand. We may perhaps cooperate to advantage with the general practitioner and also with the board of health.

Wells Block.

THE PARTIAL DENTURE AS RELATED TO FULL DENTURE CONSTRUCTION*

By CLYDE H. SCHUYLER, D.D.S., New York City

THE preservation of the teeth and the supporting structures should be the first precept of every practicing dentist; yet it appears that many dentists have considered the partial restoration as merely a stepping-stone to the full restoration. The great value of functional efficiency, esthetics and comfort, and lastly, the preservation of the alveolar ridges have not been sufficiently realized.

Fortunately, we are now approaching an era when greater interest and thought are being directed toward prevention in all branches of dental science.

Such men as Box, Stillman, McCall and Bricker[1] have taught us the significance of functional occlusion to the

*Presented as a clinic at the Sixty-Ninth Annual Session of the American Dental Association, Detroit, Mich., Oct. 27, 1927.

1. Bricker, F. A.: Diagnosis and Correction of Traumatic Occlusion, J.A.D.A., 11: 697 (Aug.) 1924.

health and maintenance of the natural dentition, acknowledging trauma as the greatest cause of loss of teeth through periodontoclasia.

Members of the National Society of Denture Prosthetists and others have done much to stimulate a study and means of producing balanced occlusion in full denture prosthesis. It is an accepted fact that the full denture is most efficient and the supporting structures are least affected by the ravages of absorption when the teeth are arranged so as to permit balanced occlusions.[2]

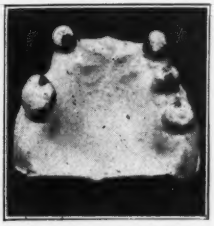

Fig. 1.—Case which should be made tooth-bearing with physiologic adaptation of saddles using either the slot attachment or clasps with rests. A tissue bearing partial denture would produce unnecessary alveolar absorption and gingival irritation. Harmony of occlusion could not be maintained and the subsequent trauma would be greater than that produced by the more rigid restoration.

The success of the partial denture depends on the stability of the teeth and the supporting tissues. How, then, can we design such restorations without giving due thought to functional occlusion and the means of maintaining this condition over the longest possible period of time?

Let us consider to what extent a partial denture may be of service. The patient expects to be able to masticate, speak plainly, present a normal appearance, experience no discomfort with the dentures, and when these results have all been accomplished, he expects, with reason, that the service shall last a moderate length of time.

Lasting results depend on three chief factors: proper mechanical design, functional occlusion and physiologic adaptation of the saddles.

Before discussing mechanical design, it is desirable, for diagnostic purposes, and as an aid in determining the type of restoration, to have a complete series of roentgenograms disclosing the health and supporting value of remaining teeth, and also revealing the existence of possible roots, etc. Good impressions should be made and stone casts should be mounted on an adjustable instrument for the purpose of studying occlusal relations, alinement of teeth to be used for abutments, positions for clasps,

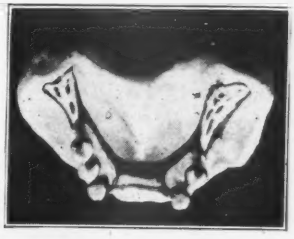

Fig. 2.—Lower partial denture made tooth and tissue bearing. A tissue bearing denture had been worn previously, giving little comfort with either the partial mandibular denture or full maxillary artificial denture, as a favorable occlusal relation could not be maintained. The denture with clasps and rests as outlined, with physiologically adapted vulcanite saddles, has been worn for several years, giving comfort, with apparently less trauma to teeth and tissue of the mandibular denture and the tissues of the maxillary ridge.

2. Sears, V. H.: Balanced Occlusions, J.A. D.A., 12:1448 (Dec.) 1925. Hanau, R. L.: Articulation, Analyzed and Formulated, J.A. D.A., 13:1694 (Dec.) 1926.

etc., and to recognize teeth which may have elongated or exfoliated from lack of occlusal contact.

We are too prone to accept the mouth as we find it. Apparent elongation of teeth may be relieved by establishing normal maxillomandibular relation, but when elongation really exists, we may find it necessary to cut down cusps. When this is impossible, and the tooth precludes a functional occlusion, it should be extracted. Abscessed teeth are extracted because they are incompatible with the patient's welfare, yet we tolerate the presence of otherwise detrimental teeth.

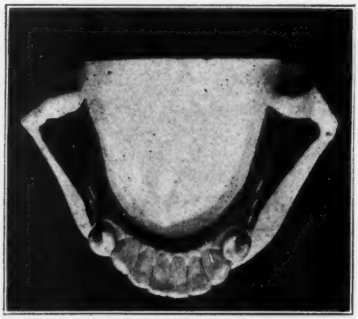

Fig. 3.—Type of case which should be constructed as tooth bearing in the anterior region and tissue bearing in the posterior region. The posterior region of the denture rests upon a broad dense area of the mandible not subject to the same condition of absorption as the high alveolar ridge in the area of the bicuspids. When fewer or less secure teeth remain, the continuous clasp should be used. Lingual bars should be rigid to maintain the proper relation between the saddles and the tissues during mastication.

In many instances, the remaining natural teeth are badly out of functional harmony, owing to uneven wear or locked occlusion. It would be useless to strive to attain desired results until these existing conditions are corrected. Occlusal surfaces should be built up to restore normal conditions, but if this is impossible or undesirable, physiologic balance should be established by grinding away the interfering cusps or tooth surfaces.

Teeth often present difficulties in clasping, owing to extreme bell contour or unfavorable inclinations. This condition can be relieved by grinding upon the axial surfaces. For instance, the lower second or third molar is often inclined lingually or mesially to such an extent that a clasp cannot be placed below the occlusal margin. By slight grinding on the lingual or mesial surface, or both, a clasp can be placed in such a position that not only will it aid in maintaining the stability of the denture without annoyance to the tongue, but it will actually prevent the tooth from being inclined to a greater degree by continued vertical stress. Of course, any surface that has been ground should be well polished with sandpaper or abrasive disks.

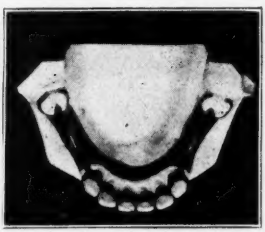

Fig. 4.—Partial case, using the continuous clasp on the anterior teeth with clasps and rests on the molar abutments. Functional or balanced occlusion could not be maintained with a tissue bearing appliance.

If teeth which are to carry occlusal rests have proximal fillings, or such restorations are necessary, insets should be made in the fillings for the rests.

All grinding should be done before the final impressions are made. The pa-

tient seldom objects to proper preparation of the mouth to receive a restoration, but often objects to grinding of teeth to fit a finished piece of work.

This leads us up to the question of proper mechanical design. We are confronted with the query: Shall our cases be constructed to be tooth-bearing, tissue-bearing or both tooth and tissue-bearing wherever that is possible?

It may be well to reach an understanding of the meaning of these classifications: A restoration in which the remaining teeth take the entire occlusal stress is tooth-bearing. A fixed bridge or a removable restoration with saddles so constructed that they do not relieve the abutment teeth of occlusal stress comes under this classification. A tissue-bearing restoration is one which depends on the tissues for support. A partial denture without occlusal rests or definite stops, and those with free-moving stress breakers, are tissue-bearing.

Fig. 5.—Case having broad ridges of dense, bony structure, favorable to the maintenance of balanced occlusion if constructed entirely tissue bearing.

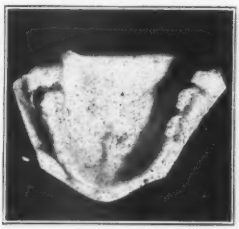

Fig. 6.—Case in which, with the posterior molars as shown, the maintenance of balanced occlusion is impossible. The extraction of these teeth and insertion of a full mandibular denture would give greater comfort and service with less injury, the alveolar structures supporting the opposing teeth whether they are artificial or natural.

I have previously spoken[3] of restorations with occlusal rests and those with slot attachments as tooth-bearing. The tissues may, in some instances, relieve the teeth to a degree, but when saddles are properly designed and physiologically adapted, they undoubtedly stimulate circulation, apparently producing a thickened cortical plate,[4] and providing firmer and better ridges for the full restoration. It would appear to me that they might be classified with other cases which may have tooth support on only one end, as, for example, the lingual bar supplying all posterior teeth.

In many instances, we hesitate to direct the stress of occlusion upon a few remaining teeth for fear of overloading them. This, of course, is a danger to be taken into consideration, but a few abutment teeth will safely carry a much greater load with a bilateral restoration than they would with a unilateral restoration, for nearly all the stress applied to the tooth is in a vertical direction; the lateral stresses are relieved by retention on the opposite side of the arch.

Let us review just what happens to the average tissue-bearing case after a few months, presupposing that we have attained a favorable result at the completion of the denture. Such cases rapidly settle, become unserviceable in

3. Schuyler, C. H.: Dent. Digest, 33:767 (Nov.) 1927.

4. Phillips, G. P.: Dent. Forum, 1:11 (Feb.) 1927; (July) 1927.

mastication and cause inflammation at the free margin of the gums of the abutment teeth or at other points in the saddle area. This is followed by rapid absorption of the alveolar ridges and loss of functional occlusion thus subjecting the remaining natural teeth to malocclusion. Furthermore, correct maxillomandibular relation has been lost, which results in a change of facial dimension, with even the possibility of impaired hearing and throat congestion. In addition, ill-results are not confined to the arch on which the partial restoration has been placed, but the teeth and supporting structures of the opposing jaw also will suffer injury from traumatic occlusion. Thus, we risk the loss of function, esthetics and comfort and may even inflict permanent injury on the patient through constructing an appliance of improper design.

Fig. 7.—Unilateral appliance using the Jackson crib and the continuous clasp which is tooth bearing in the anterior region and tissue bearing in the posterior region, the most favorable occlusion being thus produced.

The best solution of the problem would seem to be in the designing, whenever possible, of restorations which will be both tooth-and-tissue-bearing.

We are all familiar with the lingual bar restoration supplying the posterior teeth, with a few anterior teeth remaining. These cases will usually prove more serviceable when designed to be semi-tooth bearing. If appliances are made to be entirely tissue-bearing, absorption takes place most rapidly in the area of the bicuspids, where there is a narrow ridge of alveolar structure, as compared to the broad area of dense, bony tissue in the molar region, less susceptible to changes under pressure. This uneven absorption thrusts the denture forward on the incline of the mandibular ridges, creates gingival irritation, robs the abutment teeth of the alveolar support and, as previously mentioned, subjects the natural teeth to the ravages of vertical and lateral stresses far greater than required were the denture designed to be partly tooth-bearing.

Fig. 8.—A tissue bearing appliance showing the usual absorption of ridge tissue and settling of the denture. The denture is not comfortable or serviceable; does not maintain esthetics, functional or balanced occlusion or facial harmony; robs the remaining teeth of alveolar support, and subjects them to more harmful stresses than would a tooth and tissue bearing restoration.

We are all familiar with the destruction of the alveolar ridge supporting the full upper denture when it is subjected to the traumatic occlusion of a few lower anterior teeth. Surgery will remove the soft flabby ridge which affects the comfort and stability of the denture, but it cannot replace the bony structure so essential to ideal results. In a similar way, when constructed in apposition to a full lower denture, any partial

restoration on the upper arch not designed to maintain balanced occlusions will be inefficient and uncomfortable and will cause rapid destruction of the lower ridge.

Since balanced occlusion is essential to the full denture, if it is to give efficient service and comfort, together with the least amount of injury to the supporting structures, we must realize the importance of designing and constructing partial restorations which are to occlude with the full artificial denture so that established occlusal planes will remain permanent. This may be done in most instances by making the restoration partially tooth-bearing.

There are some conditions in which it is advisable to remove sound, natural teeth and to construct a full denture. It is impossible to maintain the desirable occlusal relations of a partial denture when only one or two molar teeth are supporting abutments. Such restorations are less efficient and cause more injurious results to the alveolar structures of the opposing arch than would a full denture.

The principal mechanical means at our disposal for constructing tooth-and-tissue-bearing partial restorations, and for securing their retention, are: clasps, wrought or cast, with occlusal rests; occlusal rests without clasps, and various types of slot attachments with stops.

Dr. Kennedy[5] and Dr. Woodworth have illustrated completely the use of the continuous clasp in connection with partial work. This type of construction seems to be very efficient in a large percentage of cases, as the maximum number of teeth are employed to aid in withstanding the vertical and lateral stresses. The continuous clasp may function also as an indirect retainer or, in some cases, as a splint to retain a weak tooth or teeth against adverse stresses. It may be either cast or built up from thin plate reinforced with wrought wire. All clasp surfaces in contact with the tooth must be well polished.

As always, there is some dispute relative to the value of cast and wrought clasps. I find both types of construction valuable, the choice depending on the requirements of the individual case. In small unilateral cases, the cast clasp of correct design, well polished and burnished on the inside, may be used to advantage. In some bilateral cases, in which the round or half-round wire is commonly used, I feel that a rigid type of clasp is essential. When a lingual rest is placed on the inclined plane of a cuspid, it must be used in conjunction with a rigid labial clasp to direct the stress of occlusion with the long axis of the tooth and prevent its displacement labially. Modern clasp designs and gold alloys have been improved to such an extent that there is no excuse for poor results in either cast or wrought clasps. To prolong life and efficiency, every clasp should invariably be tempered before the case is completed and delivered.

We now come to the use of slot attachments. As you are well aware, much success has been made possible when dentures, bridge, or whatever you wish to call such restorations, have been constructed with slot attachments. Would it not be well to consider the reason for such success? Is it because the tissues relieve the teeth, in a measure, of the stresses, as we have been led to believe? I question this. Such cases are tooth-bearing and tissue-bearing in the same degree as partial dentures with

5. Kennedy, Edward: Dent. Items Int., 49: 988 (Dec.) 1927.

rests and clasps. They are successful restorations because the correct occlusal relation is maintained as originally executed, and the benefits of functional occlusions, proper maxillomandibular relation, etc., exist throughout the life of the appliance.

I am convinced that but a few of the stressbreakers commonly used are of value, and stressbreakers of any form are contraindicated in most cases. In some instances, if teeth are diverging, proper clasping may be facilitated by the use of the attachment so constructed that the only movement is a rotation of the clasp on the tooth. The time is passing when we claim benefit from a freely moving denture. We know that a limited amount of stimulation is conducive to tissue development, while overstimulation causes degeneration. Usually, our problem is to so construct our restorations that a minimum amount of play or movement will exist, thus overcoming as far as possible this undesired overstimulation of the tissues.

Ridge trauma is inevitable unless proper relation is established and maintained between the saddles and the ridges. With this very thought in mind, I feel it essential to use rigid cast or built-up bars. In bilateral restorations, for example, of the lingual bar type, having no posterior abutments, the wrought bar which is flexible enough to be contoured is not rigid enough to withstand the lateral stresses of mastication.

Poor results in the rebasing of lingual or palatal bar restorations, credited to careless handling by the laboratory technician, frequently occur in the mouth while the restoration is being relined under closing pressure. Such results are due to the spring of the flexible bar.

It should be our desire to so design and to so construct our partial restorations as not only to maintain functional occlusion, function, etc., but, if possible, as we have said before, to create more firm ridges, anticipating that time when full dentures may be necessary. This requires what Dr. Phillips terms "physiological basing of partial dentures," or an equalized pressure over the entire saddle area. To secure these results, he advocates the use of black carding wax in rebasing vulcanite cases. (I have found this method to be of great value, both in my own work and the school clinic.)

L. W. Doxtater[6] has given us a very meritorious technic for securing this desired tissue adaptation of gold saddles.

George P. Phillips[4] and others have shown roentgenograms which seem to support the contention that the cortical plate is thickened by the proper function of the saddles of tooth-bearing and tissue-bearing partial dentures. There may be some question as to the percentage of occlusal stress carried by the tissues in such restorations, but experience has taught us their efficiency and comfort, with least injury to the abutment teeth. If the stimulation of such saddles produces a thickened cortical plate, thereby making a better and firmer ridge for the possible full restoration, it behooves us to take advantage of it. This point is worthy of emphasis, for we have all seen too many tissue-bearing partial restorations destroy the ridges and render impossible the making of a satisfactory full restoration.

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6. Doxtater, L. W.: "Saddle Design and Impression Technique," Dent. Cosmos, 69: 1153 (Nov.) 1927.

CONCLUSION

The successful dental restoration demands of the dentist a consideration of every associated structure of the teeth as well as that of the teeth themselves. It requires not only careful planning of the mechanical factors involved in the construction of the appliance, but also a study of the possible results arising from the presence of the appliance in the mouth of a living individual. The restoration must be worn with comfort, must be efficient in function and must restore normal appearances with least injury to the remaining natural teeth. In addition to this, we must endeavor, if possible, to retain or build up the alveolar supporting structures, anticipating that time when a full restoration may be necessary. In our partial restorations, therefore, it would seem of primary importance to adapt the saddles to the tissues physiologically, and design and construct the restorations so as to maintain functional occlusions.

576 Fifth Avenue.

CHECKING COMPLETED DENTURES FOR ADAPTATION AND RETENTION AND ESTABLISHING BALANCED ARTICULATION*

By R. O. SCHLOSSER, D.D.S., Chicago, Ill.

FOR an hypothesis, let us assume that we have before us a set of artificial dentures for an edentulous patient in the construction of which due care has been exercised, with the necessary attention to technical details, and that they have been polished and the patient has come to have them placed and fitted.

Because, in general, progressive operators are now using adjustable articulators and, for its very simplicity, many also employ the face-bow to aid in establishing the correct positional relations of the denture bases on the articulator; and more particularly because I am convinced that, to obtain best results the use of these implements are necessary, I assume that they have been used.

*Read before the Section on Full Dentures at the Midwinter Clinic of the Chicago Dental Society, Jan. 26, 1928.

THE PROCEDURE

1. Thoroughly inspect the dentures inside and out, removing absolutely any vulcanite beads or particles of investment plaster that may have escaped previous notice. Inspect the periphery of the dentures to see that they have been properly rounded and highly polished. Failure to observe and carry out the foregoing detail hampers the seating of the dentures and actually lessens or interferes with their retention and will cause faulty or improper registration of their positional relations.

2. Check the fit of the bases. Test each denture separately. Dip the denture in water to moisten it, place it carefully in position and seat it firmly upon the supporting tissues. While doing this, draw the loose connective and muscle tissue which is attached along the alveolar

border from under the denture, and displace the air by repeatedly pressing the denture to place. The patient may assist by sucking and swallowing. When the denture has been properly seated, the interposed film of saliva acts as the medium of adhesion. The border tissues are now released and allowed to drape themselves about the periphery. Now the test is made for stability by applying pressure to the occlusal surfaces and incisal edges in a manner and direction simulating the pressures that will be applied in masticatory effort. (No spectacular or extreme tests are advised.) If the denture base is reasonably stable, it is checked for overextension. This is most simply accomplished by asking the patient to perform muscular movements such as accompany speech, mastication or the modification of facial expression. If the denture is not readily dislodged, the tissues are not blanched, showing overcompression, and the patient does not complain of discomfort, it is assumed that the adaptation developed during the taking of the impression has been maintained. If the dentures show a lack of stability or retention, corrections must be made before proceeding further, as ill-fitting bases can never be of much service.

3. If stability and retention are found to be satisfactory, we proceed to check the positional relations of the dentures. For this purpose, use the Hanau intraoral method of checking the jaw relation via the occlusions with the aid of interposed wax records in the unstrained and the strained relations. To detect as fully as possible errors in the occlusion which may be due to either false previous registrations or to some disturbance or transposition of either of the bases or the teeth resulting from some uncontrolled changes during vulcanization or other causes, it is necessary that both dentures be again mounted on the articulator.

Where gold bases or the careful double vulcanization method has been used, we have the advantage of having preserved the position of the maxillary base in the attached mounting cast on the articulator; and if previous registrations are proved to be correct, we have the further advantage of having also preserved the correct positional relation of the mandibular base. When the single vulcanization method is employed, a remounting record for the maxillary denture should be made to facilitate the replacing of the denture after vulcanization without making it necessary to again use the face-bow. The method of making remounting records has, on different occasions, been described by M. M. House, R. W. Tench and R. L. Hanau. It is made by obtaining an imprint of the closing surfaces of the maxillary teeth in plasticine, wax or plaster of Paris, before removing the model dentures, prior to vulcanization, and attaching to the lower part of the articulator in a manner that will permit an easy remounting in the original position. This is done by placing the finished maxillary denture on the imprint and reattaching it to the articulator with plaster of Paris.

To verify the correctness of the previously recorded position of the mandibular denture, or when, as in single vulcanization, the cast supporting this denture has been destroyed and it is necessary to reestablish the correct positional relation for it, a new mouth record of the unstrained centric relation is made with the dentures and is used to maintain this relation during the transfer to the articulator till the plaster used to reattach it has become thoroughly

hard. In the former case, this record is used on the articulator as a check record; while in the latter instance, a new articulator record is made to check the last mounting. If, at this time, no error is found in the positional relation of the dentures, we proceed to the next step.

4. We now check the indication of the articulator condyle guidance. A new mouth record of the unstrained protrusive relation is made, and is used either to check the previous setting of the indication, or, if the record is found at variance with it, the indication is reset and rechecked by using new articulator records of 6 mm. protrusion. If it is now found that the patient can register perfect occlusion in these positions as recorded on the instrument, it may be properly assumed that the case is correctly mounted and the indication for the condyle guidances is correctly set. Further proof that the instrument in use will permit the development of articulation well balanced in other functional positions may be readily obtained by making articulator records of the right and left lateral excursions and checking them in the mouth.

5. Next, we check the bite records or records of the strained relations. To insure the proper distribution of the pressure that will be applied to the supporting tissues in the strained relations, bite records are employed. They differ from the rest records or records of the unstrained relations only in that, when checking with these, the wax is less plastic and the patient is asked to apply pressure as in biting. By this means, it is possible to compensate for the variance in the magnitude of the tissue resiliency, first, by balancing the occlusion under strain, and by increasing or decreasing the vertical bulk of wax at certain points of the records to which the biting forces are applied, and then to provide for working out corresponding balancing contacts of the porcelain teeth by slightly transposing the denture bases in the vertical relation to compensate for the resilient and like effect of the tissues. The proof of a balanced bite is in the ability of the patient to apply biting pressure without discomfort or dislodgement.

6. This step covers the articulator diagnosis. At this time, after the dentures have been checked both in the strained and unstrained relation for various positions and the proper instrument adjustments have been made, we are ready to diagnose the type and magnitude of the errors in the occlusions of the teeth. It is our ability to correctly diagnose these, as well as our knowledge of the laws of articulation, which enables us to tell what cases are within and which without or beyond the limits of correction by stone and paste grinding. The cases showing an extreme protrusive error are generally not correctable by this means. Cases showing lateral errors are very difficult to grind in, as here the lack of necessary lateral contacts would call for too a great a sacrifice of tooth material buccolingually. Cases not over 2.5 mm. in retrusive occlusion and showing no extreme changes in the indication of condyle guidance can usually be balanced. Cases showing vertical interference in the posterior region, with resultant lack of anterior contacts, are ordinarily simple to handle; while cases in which there is a lack of contact posteriorly and considerable anterior interference would necessitate tooth mutilation, and therefore this sort of treatment, could give few beneficial results.

Those cases that cannot be ground in to balance can, at times, be corrected

by a transposition of either the arch or the base of the mandibular denture. Some may be corrected by rebasing, others require the resetting of the teeth of one or both dentures, using the original base; while still others are so badly off as to require remaking.

7. In balancing the occlusion by stone grinding, it is advisable to proceed systematically. We advocate locating and eliminating the errors found in one relation at a time, and we begin in centric relation to spot the interferences and grind them away with the small mounted stones. (I employ two particular types of stones for this purpose, one a one-eighth by five-eighths inch wheel shape; the other, an inverted cone about three-sixteenths inch at its largest diameter. The larger one is used wherever access may be had for it; the smaller one, in deepening the sulci and modifying the triangular ridges of bicuspids and molars.) The judicious use of articulating paper assists in spotting the interferences, but the too free use of it gives multiple smears that mislead and are but a handicap. The spotting and grinding is continued till good closure in centric relation is effected.

Next, the points of interference on the working and balancing sides in the right lateral relation are located and are ground off in such a manner as to preserve the maximum of tooth form or anatomy and bring about the required contacts. This means the maintenance of inclined planes or their modification, and it may require that sulci be made deeper or cusps shallower; in other words, the practical application of the laws of articulation as formulated by Hanau. A similar procedure is applied to the left lateral relation, the grinding being continued till cusp interference is eliminated and needed contacts are established. Lastly, the same technic is applied in the protrusive relation, after which the abrasive paste is applied and the teeth are milled in.

8. The dentures should be correctly seated and firmly luted to the mounting casts before the paste is applied; in fact, it should have been done before the spotting and stone grinding was done, in order to avoid a shifting of the bases or the possibility of the dentures falling off and breaking. The abrasive paste used for this final grinding or milling-in may be made by mixing a fine grit of carborundum or emery powder with "K Y jelly" or a similar adjuvant, or can be procured already prepared in convenient form. I prefer the latter. It comes in collapsible tubes, and is applied to the masticatory surfaces of both dentures. The grinding is done by simulating the mandibular movements performed in the chewing of food.

The articulator is placed upon the work bench or table, and the mandibular member is held down firmly with one hand while, with the other, the maxillary member is moved about. Starting from centric position, it is lifted and carried to a lateral position, allowed to close and then carried back to centric occlusion. The movement at first should be slow and cautious to avoid chipping or fracture. Speed may be increased gradually. No vertical pressure is applied except that resulting from the weight of the maxillary element. When the teeth seem to glide smoothly, similar movements are performed from the opposite lateral to the centric position. Then the teeth are brought to the protrusive position, and the stroke is from this position to the centric. When during the latter grinding movements no interference is felt, some intermediate strokes are performed until the movements in all di-

rections can be freely made. In this grinding, the movements should be carried to positions of slight overprotrusion in order to eliminate any cuspal interference that might be encountered outside the normal functional range.

It is to be expected that all new dentures will settle down somewhat in the first twenty-four hours, particularly in the posterior region, which results in a slight transposition of the dentures. This brings the incisors into more intimate contact relations and may cause either trauma or interference to free movement and at times a tipping of one or both dentures. In anticipation thereof, the indication of the horizontal condyle guides is increased 5 degrees after the general clearance is reached and the grinding is continued for from another half to a full minute to establish a slight additional clearance for the anterior teeth. If the stone grinding has been carried out to the point of eliminating major interference and establishing the necessary contacts, the time consumed in the paste grinding should not exceed from five to ten minutes.

I do not favor the motor driven devices such as are coupled up with the articulator to do the grinding. I grant that abrasive paste and motor power, when applied to porcelain teeth, will grind them down, but no device yet produced can replace the digital sense on which the operator should place his dependance. As has been previously inferred, the aim in both stone and paste grinding is to perfect the contact relations of the teeth; i. e., to establish within reasonable limits a precisely balanced occlusion for all functional positions. Yet this should not be done wantonly, destroying the tooth forms and robbing them of all semblance of anatomic form and conformity to functional requirement. After this milling-in with paste, the ground surfaces are polished to eliminate any roughness and scratches which might annoy the patient. The dentures are now thoroughly cleaned and replaced on the articulator; a further check-up is made to ascertain that they fully comply with all requirements, and they are placed in the mouth, where they are once more inspected to see that they are as truly balanced there as they were on the articulator. If they are so balanced, we may rightfully assume that the technic and the instruments employed may in truth be termed scientific.

The patient is now instructed to return in twenty-four hours for a further check-up and adjustment, after which the case is kept under supervision for thirty days, during which time the patient reports periodically for examination and needed adjustments and corrections. As yet, we have not achieved the ideal in denture construction; and because, in the condition which our edentulous patients present from time to time, we must admit, there is still much that often perplexes us, we should guard ourselves in what we promise to do for them. This, however, should not deter us from giving them the utmost in service that an honest application of our scientific knowledge and skill will permit.

CORRECTION OF MALOCCLUSION IN ARTIFICIAL DENTURES

If we are to discuss malocclusion of artificial dentures logically, we must begin with diagnosis, ascertain the causes, formulate a prognosis and outline the treatment. It is along these lines that I shall proceed.

Diagnosis: This begins with an inspection of the dentures and as we de-

sire to be as inclusive as possible, we will consider old as well as new dentures. A check-up is made to determine the degree of adaptation and peripheral extension and to ascertain the amount of adhesion in the absence of occlusion. Dentures showing poor adaptation and severe underextensions are not considered worthy an attempt at correction. Dentures fairly well adapted but overextended are first trimmed to eliminate the overextensions. An examination is next made with the dentures *in situ*. The type and magnitude of the error is studied, while the patient is asked to bring the teeth into occlusion in the jaw positions of centric, right lateral, left lateral relation and protrusion. Even slight errors are more readily corrected on the articulator, and full or complete diagnosis requires that the dentures be mounted thereon. While it is possible at times to make a prognosis without an articulator mounting, there are, in fact, no cases that can be so thoroughly analyzed in the mouth alone.

Articulator diagnosis: This requires, first of all, the establishing of the correctly recorded positional relations of both dentures on the instrument, as also the correct setting of the condyle guides with the accompanying check records. In the case of new dentures, when it has been found that errors too great for correction by the grinding-in process have developed and the maxillary mounting cast is still attached to the articulator, the face-bow is not needed; but where this mounting has been destroyed, as in the case of old dentures, the face-bow is used to record the position of the maxillary denture and to transfer it to an equivalent position on the instrument. Next, a mouth record with the mandibular denture in the unstrained centric relation is made and, by the aid of it, the equivalent of this relation is established on the articulator. Next, a mouth record of the unstrained protrusive relation is registered, and with this the horizontal indication of the condylar guides is set. The lateral indication is then set, either by formula or by the use of lateral mouth records, and articulator records are made for checking purposes. The positional relations are now checked, and if no further positional errors are discovered, we are ready to study those in the occlusions. While making this diagnosis, we must ever keep in mind that though primarily we are concerned with occlusion, we are to give due attention to esthetics and phonation, and any changes that are contemplated must include a consideration of these factors or functions.

Malocclusion may be classified as retrusive, right and left lateral, protrusive and intermediate. It may cause lack of contact, or cuspal interference in any or all positional jaw relations. If uncorrected, it will cause tissue trauma, atrophy or hypertrophy, bone resorption and other undesirable tissue changes, with resultant loss of adaptation and adhesion, as well as serious facial distortion.

Once the case is on the articulator, it is but necessary to scrutinize it when the type and magnitude of the errors become apparent. To record one's findings requires no great effort; to make an intelligent prognosis is the real problem. It is in making the prognosis that a knowledge of the laws of articulation prove extremely helpful, remembering the main factors in these laws and the reciprocal influence of the factors involved. Let us make a practical application of them as we study the plane of orientation, the compensating curve, the inclination of the condyle guidance and

the cusp height of the case in hand to determine which of these may be left undisturbed and which are to be modified and how. In other words, what practical means have we at our disposal for making the needed corrections? In answering this question, we will first assume that we have a case in which the denture bases are satisfactory. A case of marked protrusion would call for a transposing of the mandibular teeth by resetting. A case of marked retrusive occlusion might be corrected either by a transposing of one arch *in toto,* or of the teeth, by resetting. Cases of lateral error might be treated in a similar manner, this depending on their magnitude and the effect of their transposition on the esthetics. This applies also to cases showing intermediate errors. Cases showing great variance between the inclination of the condyle guidance and the compensating curves may require the resetting of the teeth of both dentures. The transposing of the teeth of either arch *in toto* may be done by separating the arch from the base by means of fine saws and reattaching first with wax and then by vulcanization, or by rebasing and effecting the change by registering the correct position either during the rebasing in the plastic impression material or by means of records taken with the denture after rebasing. Whatever means are employed in transposing, when the teeth are reset they must ultimately be balanced by the stone and paste grinding method, as previously described. It is to be understood that, in all cases in which corrections are carried out, it is advisable to try the denture in the mouth and check up on appearance and phonation as well as the much referred to positional relation.

Anticipating the question: What advantages are there in the correction of badly occluded dentures over remaking? I venture this answer: To have, even through the medium of malocclusion, attained the evidence of correct positional relation is a distinct advantage. Having done that, the correction itself is merely a matter of technic. We know that, in spite of all claims to the contrary, the obtaining of correct registration of positional relations is not merely a matter of technic, but also a matter of complex conditions in the crippled mouths of our edentulous patients; and because we can, by the correction methods outlined, save the time and energy of both patient and operator and avoid a repetition of hazards previously encountered, we are firm in our advocacy of it. A certain percentage of the cases of malocclusion in artificial denture work are undoubtedly due to tissue changes that take place, even though, when the case was constructed, it checked satisfactorily. This is most apt to occur in the extreme prognathous cases and is due to the transposition of the denture bases caused by the tissue changes.

PARTIAL DENTURES: THEIR RETENTION AND CONSTRUCTION*

By WALTER F. CHAPPELLE, D.D.S., Buffalo, N. Y.

PARTIAL dentures, according to the usually accepted definition, are restorations for lost portions of the dental arch, usually retained by clasps, and essentially resting on the ridges and not abutment supported. So made, they have always been more or less troublesome because unusual care was necessary in their planning and construction, for the following reasons: 1. Accurate impressions were needed from which to make accurate models, and it would pay most practitioners to give considerable time to perfecting this step. 2. Correct centric occlusion and other mandibular relations seemed troublesome to procure. 3. Abutment teeth of unfavorable contour made clasp design difficult. 4. The remaining teeth tilted, in their long axis or, unfavorably situated interfered with placing and removing restorations. 5. Lack of properly developed articulating surfaces resulted in excessive stresses on the various parts of the dentures or on the ridges and abutments. 6. Resiliency of the tissues or absorption of the ridges destroyed masticatory efficiency and changed the location of the clasps on the teeth. 7. Inaccuracy in clasp construction left unopposed forces on abutments, causing movement of the clasped teeth or misplacement of the saddles.

In previous papers, I stressed the necessity of varying the clasp design to meet as far as possible the many situations arising from tissue support of dentures; of constructing clasps accurately so that drifting or soreness of the abutments would not result, either at the time of first being placed in the mouth or later because of a reasonable amount of tissue resiliency or of ridge atrophy, and that the case should not be hard to remove or replace owing to failure to compensate the irregularities of tooth contour or alinement; also, that unequal clasp pressure should not displace the saddle relation to the supporting ridges. The use of ridge supported partial dentures will always be preferable to a certain proportion of operators and will be advisable to all in a limited proportion of cases, and you are again urged for such tissue-supported restorations to study clasp design and use great care in construction and adjustment.

After careful consideration of the difficulties arising in such varied clasp design and construction, together with the possible development of trouble from temporary or permanent settling of the dentures, with the loss therefrom of occlusal contacts, I feel that less danger to the abutments and remaining teeth, combined with greater and continued masticatory efficiency, would result from the use, wherever possible, of abutment support, provided a carefully and accurately

*Read before the Section on Partial Dentures at the Midwinter Clinic of the Chicago Dental Society, Jan. 24, 1928.

ground coordinated occlusal plane is developed.

Where occlusal rests are used, the uncertainty as to the extent of movement due to tissue resiliency or as to continued settling due to ridge atrophy is absent; also the resultant menace of unequal torque development from settling of clasps is removed. This leaves only the choice of abutments; proper design and construction of clasps and bars, and the articulation to be considered. The choice of abutments and design are admirably covered by Dr. Cummers' rules and charts. I have stressed clasp design in previous papers. The menace to be met in planning and making them is reduced to the immediate prevention of any unfavorable or unequal forces in placing, removing or wearing the clasps. Forces that would cause any soreness, movement, drifting or tilting of the abutment should and can be prevented. Such forces may cause displacement of the saddles rather than movement of the abutment teeth. The inaccuracies that cause trouble are: uneven tension of clasp arms; careless adaption of clasp arms to the surfaces they parallel, and careless location of clasp contact so that they do not oppose each other on opposite sides of the tooth on lines through the tooth at right angles to the long axis.

The articulating surfaces of the restored teeth, together with those of the remaining natural teeth, must be carefully coordinated with normal mandibular movements so that unfavorable masticatory pressure cannot be applied. For the same reason, the total surface in occlusal contact must be carefully cut down to the limits of tolerance. This need not be accomplished by reducing tooth area or the number of teeth, but by the use, as far as possible, of line and point contact, which is best developed in convex cusps with liberal escapes in the form of rounded borders, crests and grooves. It is usually advisable to invite mastication on favorable teeth on the restoration by giving a little broader surface contact instead of only line and point contact on such teeth.

The actual construction of cases is a matter of preference and the skill of the individual operator, in conjunction with the discrimination and financial status of his patients, influenced by the permanency of the mouth conditions. But, remembering that what is ideal may not always be practical, and vice versa, cast clasps in one man's hands may be far superior to wrought wire and, with another operator, the opposite is true. Whether wrought or cast clasps, one piece or assembled castings, all metal or part rubber is chosen is of minor importance to the proper design of parts and the correct articulation. Use whatever in your hands meets best the requirements of mouth conditions, ability to pay and discrimination of each of your patients. There is one word of warning advisable when clasps are cast: The grip of such a clasp is very accurate and, under certain conditions, where movement of a tooth on its long axis would result from lack of abutment support of one end of a saddle, necessary relief must be given by grinding some of the tooth-bearing surface of the clasp or using the proper stressbreaker. The advantages of abutment supported over ridge supported cases are as follows: 1. Choice of abutments and clasp design are simplified. 2. Clasps cannot settle and damage the abutments. 3. There is less chance of soreness from pressure on soft tissues. 4. There is greater masticatory efficiency owing to rigidity of abutment support over resilient tissue support. 5. There is

no chance of later loss of efficiency due to settling, with ridge atrophy. 6. The use of the entire arch is encouraged because equal pressure can be maintained everywhere. 7. For the same reason, the remaining natural teeth are actually protected, because, if the case settled by reason of ridge atrophy, all the stress from mastication could fall on the remaining teeth anyway. Wear from stress could be more rapid owing to fewer teeth remaining in good contact, and the natural teeth opposing those on the partial denture could elongate or would at least lose the benefits of occlusal contacts. For example, assume that the teeth from cuspid to second molar are missing on both sides: If a tissue-borne case rested on very resilient or shrinking ridge tissue, the patient would soon lose contact between the natural bicuspids and first molars and those on the dentures, and the patient would then shift mastication to the anterior teeth, which are unfavorable for mastication, and the opposing natural teeth would lose the benefits of occlusion. Likewise, the fewer teeth in hard contact, incisors, cuspids and second molars, would wear down more rapidly. If rests were used and firmer contact maintained, the patient would use the bicuspids and molars, and the second molars supporting the case would be better able to stand their part of mastication on the supplied bicuspids and molars than the six anterior teeth which would otherwise get all the work.

In cases in which no posterior abutment exists, abutment support of the anterior portion of the saddle is still usually better because the mastication can be encouraged by the use of a little broader plane surface contact in the second bicuspid region and line and point contact only on the teeth farther back. As a result, then, only the anterior half of the saddle is carried on the first bicuspid or cuspid and the other half of the saddle is carried largely by the broad portion of the ridge in the third molar region. Diagrammatic comparison with a lever of the second class will illustrate the advantage. If the anterior abutment support is not used, the entire saddle would be likely to settle, especially in its anterior portion, where the ridge is usually narrowest, and mastication would shift entirely to the anterior teeth.

The serious factor in this recommendation is the use of coordinated convex cusp planes and the proper correction of the entire occlusal plan of the mouth, if possible; which requires skill and study. But since every phase of dentistry today requires careful handling of the occlusion, it is more likely to be given the proper study than would a widely varying clasp design for special requirements or the proper use of stress breaking designs for each case. Further, the variance in cusp contact between natural and supplied teeth, together with increased variation as atrophy might occur, is not met when tissue support is used.

A decided stand has been taken in this paper because coordinated balanced occlusion makes such a thing possible. Such occlusion is the most important factor in dentistry today. It is my conviction that the short excursion (short overbite, relatively low curve of Spee and limited cusp length), using convex cusps with line and point contact and rounded borders and cusps with liberal escapes, or as close an approach to these as practical, will be the simplest, safest and most efficient occlusion to use.

THE IMPORTANCE OF SPACE RETENTION IN MAINTAINING OCCLUSION*

By BURNE O. SIPPY, B.S., D.D.S., M.S., Chicago, Ill.

THE principle of restoring occlusion and maintaining a full complement of teeth in mutilated cases by artificial means where necessary is a safe and sane procedure and in the end the patient profits greatly by such management.

It should be remembered, in making a diagnosis and case analysis, that a complete case history, full mouth roentgenograms, orthodontic casts and photographs are essential. Frequently, it is necessary to have extra-oral roentgenograms and a face mask cast in addition. The general features should be carefully studied to get as broad a view of the conditions as possible; when the specific details may be worked out more accurately. The classification of the malocclusion should be determined and should be the principal basis of the plan of treatment and the retention plan.

According to Angle,[1] all malocclusion is divided into three groups. Class I malocclusion is characterized by a normal mesiodistal relation of the jaws as indicated by the normal position of the first permanent molar. Both jaws are equally underdeveloped, being short and narrow; or, rarely, both jaws may be equally overdeveloped, being wider and longer than normal. About 70 per cent of all cases of malocclusion fall in Class I. Class II, Division I is characterized by a distal relation of the lower arch as compared with the upper arch, either unilateral or bilateral. It is characterized by a long narrow upper arch with protruding upper anterior teeth and an underdeveloped mandible, and is usually associated with mouth breathing. Class II, Division II has similar characteristics except that the upper arch, which has retruding upper anterior teeth, is nearly normal in width, is somewhat short and is not associated with mouth breathing. About 25 per cent of the cases of malocclusion fall in Class II. Class III is characterized by a mesial relation of the lower arch, either unilateral or bilateral. The mandible is over-developed, usually longer and wider than normal, and the maxilla is underdeveloped, being short and narrow. About 5 per cent of cases of malocclusion fall in this class.

With this brief sketch of malocclusion and the characteristics of the bone formation, it is readily noted that a large percentage of malocclusion involves the underdevelopment of the arches in width and length. This fact I believe to be significant from a functional point of view. Dental arches that are short and narrow will have a high and narrow palate. The floor of the nose will, therefore, be narrow, the sinuses underdeveloped, the septum deflected and the teeth crowded or protruding. The tongue

*Read before the Illinois State Dental Society, Rock Island, May 11, 1928.

1. Angle, E. H.: Malocclusion of the Teeth, Philadelphia: S. S. White Dental Manufacturing Company, 1907.

will not take its normal position in the roof of the mouth, and will not exert its normal pressure on the lingual surface of the teeth and the bone, but will be carried in the floor of the mouth inert. The mandible sags, the lips and cheek muscles are functionless, and there is a lack of muscle tone from within and outside the denture.

Let us now consider the development of the human denture, particularly in its physiologic transition from the deciduous to the permanent. We have been given a time for the loss of each temporary tooth and the eruption of each permanent tooth. We have been given the time of calcification of each deciduous tooth and each permanent tooth from its beginning to its complete calcification. The ages given are, of course, the average taken from a number of known cases. The range of averages is given to allow for variability for a larger percentage of cases. Yet we find individuals far ahead or far behind in the time of calcification and eruption of teeth. It is not the average denture in point of calcification and the eruption time of teeth that concerns us most in this connection, but the unusual, those showing early or late calcification and eruption time.

Fig. 1.—Normal physiologic process in the development of the denture. (Composite drawing of three roentgenograms.)

There are certain known causes, and there are undoubtedly unknown causes for these conditions. Certainly the problem of diet is important. An early calcium-deficient diet would presuppose delayed and imperfect calcification of teeth and probably delayed eruption time. A history of rickets usually is associated with early eruption, which may be explained by the ready absorption and changing of the bones. It is particularly noticeable in cases of malocclusion under management that the teeth move readily and that the bone changes rapidly. Such cases are more difficult to retain as the period of retention must be more positive and of longer duration. The prognosis is for the same reason less certain. The opposite condition is quite as significant: the resisting bone, the late eruption time, the difficult movement of teeth under orthodontic management, the more simple retention, the shortened time of retention and a more certain prognosis.

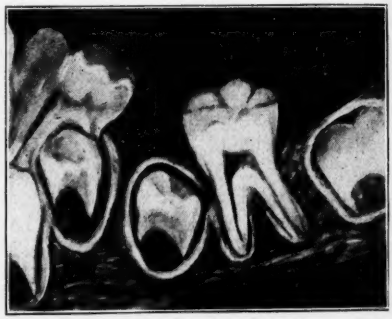

Fig. 2.—Premature loss of temporary molar, without space retention. (Composite drawing of three roentgenograms.)

The history of a child in regard to the eruption time of the teeth, particularly in an advanced stage of development, is often difficult to obtain and not reliable. Likewise, in most instances, there is little

help from the parent as to the early diet of the child. So we turn to the full mouth roentgenogram for assistance. The more roentgenograms of growing jaws that are studied and the more carefully they are studied, the more we face the realization of how little we are able to interpret from them; but that little is invaluable and oftentimes is the only help available. The roentgen-ray usually settles the question of the extent of calcification, something more or less definite as to the character of the bone and the presence or absence of unerupted teeth, the presence of supernumerary teeth, the presence of caries, etc.

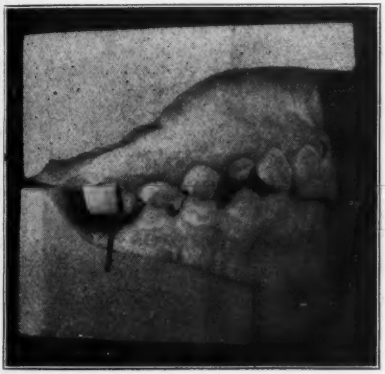

Fig. 3.—Original model showing effect of loss of lower first permanent molar, supraclusion of the upper molar and distal shifting of the lower bicuspids.

Accidents to the deciduous denture, particularly in very young children, and the secondary damage to the developing permanent tooth germs are difficult to manage. Many times, nothing of value can be done, although frequently some form of temporary splint or a deciduous orthodontic appliance may be placed to correct the displacement of deciduous teeth and thereby give freedom to the otherwise cramped unerupted permanent teeth; which prevents malformation or malposition of the permanent teeth involved.

In the premature loss of deciduous teeth, we find a regular and almost certain cause of malocclusion. (Figs. 1-4.) This premature loss may be the result of neglecting a carious condition and the progress of destruction may warrant early extraction. Should this occur in the area where there is no developing permanent tooth soon to take its place, the mutilation is greatly increased. Not only do we find the usual malocclusion resulting from the premature loss of de-

Fig. 4.—Retention model showing the effect of management and space retention. The second molars are in normal occlusion and the supraclusion and distal shifting have been corrected.

ciduous teeth, but also the lack of any development in the bone because of the absence of the corresponding or adjacent permanent tooth. In all such instances, it is not so much the loss of the temporary tooth as the failure to provide adequate artificial space retention that causes the damage to the developing denture.

Even after all of the teeth are erupted, accidents occur that may remove the

teeth completely or make their removal necessary. This is usually necessary when a tooth is in the line of fracture of the maxilla or mandible.

There are two forms of extraction, the necessary or unavoidable and the pernicious. When the child comes to the dentist for the first time with a tooth so badly involved by caries that it is not possible to save it, the tooth must, of course, be extracted. Then there is the pernicious extraction of a perfectly normal and healthy tooth to correct the crowded condition of certain teeth. This may relieve the situation for the time being, but inevitably produces serious consequences at a later date, perhaps years after. Where a permanent tooth has been lost completely by accident or as the result of caries, space retention should be employed at once, and should be continued until such time as one reaches the age when a permanent restoration may be made judiciously. This form of prevention of subsequent malocclusion is frequently overlooked, and unless it is carried out, there is usually some shifting of the teeth or a failure of complete development of the arches; and when the time for restoration arrives, a patchwork job results which is always unsightly, inefficient and a continued source of annoyance, worry and trouble to the individual.

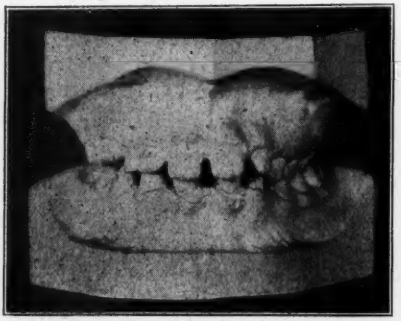

Fig. 5.—Original model illustrating the influence of congenital absence of the lateral incisors without timely space retention.

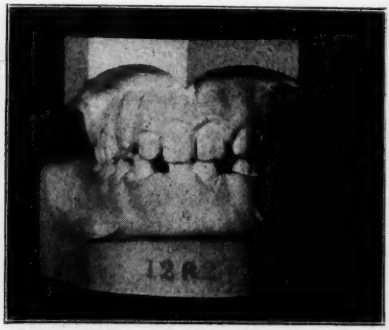

Fig. 6.—Retention model showing the result of management and effects of space retention.

At this time, it should again be said that the old theory, unfortunately accepted by so many, that, should the permanent molar or molars be lost for any cause, the second molar will move forward taking the place of the lost first molar and the third molar move forward and take the place of the second molar, is not, I hope that I have helped to prove,[2] a scientific statement. In only a very small percentage of cases under the most favorable circumstances does this theory prove true. The larger percentage of cases develop malocclusion of one form or another, serious to a degree which is comparable to the time of the extraction in respect to the developing denture and the extent of the disturbance in normal development prior to that time.

As far as is known, there is no satisfactory scientific explanation for con-

2. Sippy, B. O.: Effects of the Loss of the First Permanent Molar, J. A. D. A., 14:1953 (Nov.) 1927.

genital absence of teeth. There are those who are inclined to believe that hereditary influences are the cause. In all such instances, the absence of the teeth should be recognized early, and space prepared and maintained by suitable space retainers until the denture has reached its normal development. (Figs. 5-8.) One must use reason as there are times when such management is impossible or impractical, but this is the exception rather than the rule. The management of mutilated cases is as different as the mutilations are different, and as difficult as the extent of the mutilation.[3]

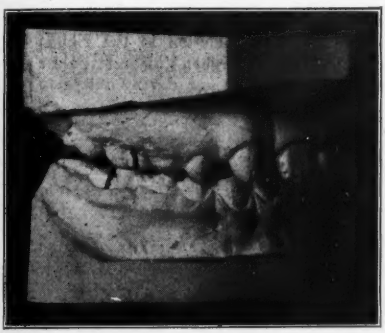

Fig. 7.—Original model illustrating the influence of congenital absence of the upper lateral incisors without space retention.

We must consider the physiologic and pathologic absorption of the roots of teeth. If the absorption of deciduous roots is normal and keeping pace with the development of the corresponding permanent tooth, there is not likely to be concern. If the absorption is going on normally with no evidence of the corresponding permanent tooth, the situation becomes a very important one and trouble in that area of the denture is pending.

3. Sippy, B. O.: Consideration of Malocclusion in Mutilated Cases, J. A. D. A., to be published.

With the premature loss of a deciduous tooth by caries associated with an abscessed condition, the soft tissues overlying and the bone surrounding the developing tooth are pathologic, and the permanent tooth erupts with difficulty and is late if it erupts at all. During this delay, other things are probably happening or about to happen in the denture to disturb its normal development. By cutting away this tissue, similar in character to scar tissue, and perhaps removing the overlying bone, and by even a slight agitation of the crown of the underlying tooth, the normal forces may

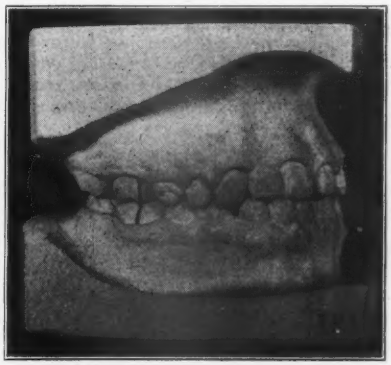

Fig. 8.—Final model showing the results of management and artificial space retainer (removable bridge) in place.

be activated and cause the tooth to erupt promptly. On the other hand, nothing that can be done may have any influence, and there will perhaps be a period of months, possibly a year or two, before the tooth in question erupts. If the individual is normal and healthy, if growth of the jaws has been normal, if the functions of respiration, mastication, etc., are normal and if the rest of the occlusion is good or within normal influences, there may be no serious consequences from this delayed eruption. But with other dis-

turbances in balance within the denture and from without, lack of development or collapse of the arch, with consequent beginning, maintaining or increasing malocclusion, is probable.

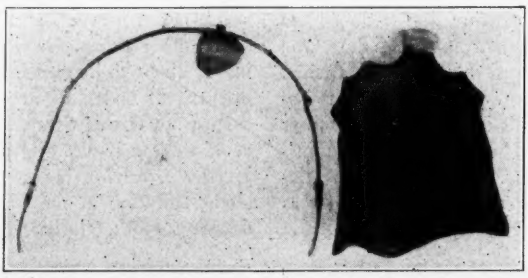

Fig. 9.—Left: Porcelain dummy bracket banded and included in the ribbon arch as a space retainer during orthodontic management. Right: Vulcanite palate retainer with porcelain vulcanite central tooth as a space retainer during retention period following orthodontic management.

The performance of space retention should be divided into two groups: first, those cases in which there has been no orthodontic management; and secondly, those in which the malocclusion has been under management. In the former, the space retention is confined to that particular part of the denture. In the latter, the orthodontic treatment plan and the entire retention program must be taken into consideration. One might conveniently divide those cases that have not had treatment into three groups: deciduous, mixed and permanent, or adult, dentures. In the deciduous denture, we have the most difficult problem to solve: first, as to the necessity of space retention, and secondly, as to the kind of retention to employ. Every proximal filling, if promptly and properly placed, performs the function of a space retainer. Filling should not be overdone; that is, it should not do more than restore the normal contour of the tooth being filled. If two approximal surfaces are so badly broken down that a normal filling cannot be made, something additional may be done. For example, it is simple and practical to make a plain orthodontic band for one of these teeth, with a spur of wire soldered to it engaging the adjoining tooth, if this space is short. Or the crowfoot end may be used (a sort of clasp at one end), if the space is too long. When the entire tooth is absent, plain bands may be made for the teeth on either side of the space, and joined with a wire soldered to both bands, which are then cemented to place. Efficient and serviceable retainers may be

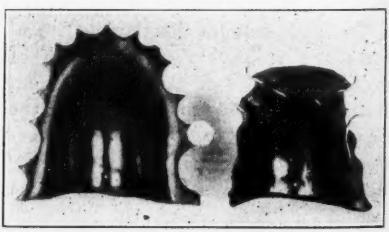

Fig. 10.—Left: Vulcanite palate retainer with porcelain vulcanite bicuspid tooth as a space retainer. Right: Vulcanite palate retainer with 0.030 gold-porcelain wires imbedded in the vulcanite as temporary space retainers.

cast in gold as onlays, or overlays for deciduous molars.

The longer the space retainer is expected to serve and the more complicated the conditions are, the sturdier and the more complicated will be the plan of the space retainer. In mixed dentures, there is a great danger of overlooking the necessity for space retention, hoping that Nature will take care of the situation, as it will in some instances, but not in all. In the permanent denture, permanent space retention should always be established where there is missing tooth structure in the form of fillings, bridges and partial dentures of any type that is suited to the conditions. The restoration should be made promptly. If for any reason it is thought advisable to delay for a period of time, temporary space retention may be quickly, easily and effectively used; for example, a plain orthodontic band with soldered wires, two plain bands with connecting wire or spurs or a temporary bridge consisting of plain orthodontic bands with a porcelain bridge facing ground, fitted, backed in the usual way and soldered to the bands. Vulcanite pieces (Figs. 9-12) with spacing wires embedded in the wax before flasking or vulcanite extending into the space involved to reproduce the missing tooth

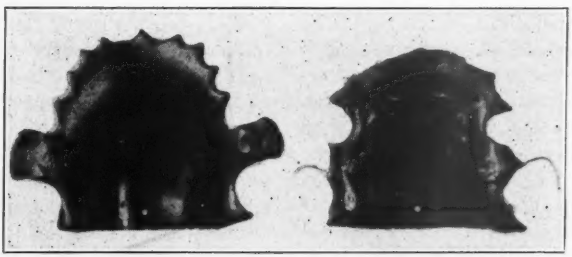

Fig. 11.—Left: Vulcanite palate plate with vulcanite carried into the spaces and carved to contour and occlusion with vulcanite burs. Right: Vulcanite palate plate with vulcanite carried into the spaces and 0.030 gold-platinum wires also to maintain spaces for the unerupted teeth.

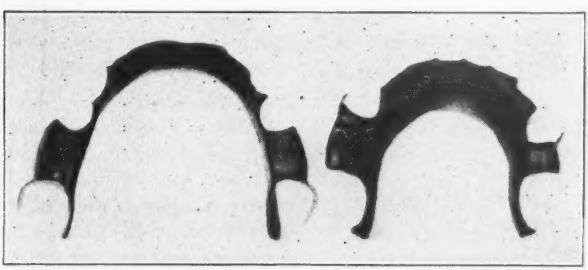

Fig. 12.—Two types of lower vulcanite retainers showing vulcanite carried into the spaces carved to occlusion and also bearing 0.030 gold-platinum wires to assist in maintaining spaces.

or a porcelain vulcanite tooth included in the vulcanite are efficient space retainers.

In the group of patients undergoing orthodontic treatment, the plan of retention as to any given space is not unlike the suggestions made, except that it is worked into the rest of the plan of retention, which may be quite complicated. When the second temporary molar is missing, I have used a plain split anchor band (Fig. 13) that is without the buccal tube, on the first permanent molar with an orthodontic "G" wire soldered to the end of the screwpost and extended to the first temporary molar or the first bicuspid with the crowfoot end, which may be worn comfortably and safely for a long period of time, until the second bicuspid erupts sufficiently to maintain the space by its own efforts in the process of eruption.

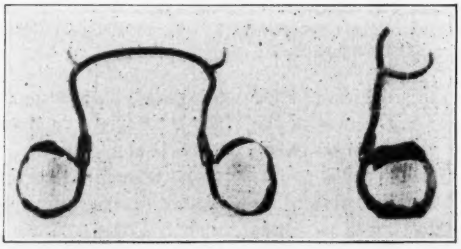

Fig. 13.—Two types of lower space retainers, using Angle anchor band and "G" wire.

The few suggestions mentioned as to types of space retainers are not exhaustive by any means, but they may serve to illustrate the principles on which a space retainer may be constructed to accommodate a given case.

CONCLUSION

I desire to emphasize again the importance of space retention in maintaining occlusion. Permanent space retainers in adult mouths are too often neglected and as a result the teeth usually shift, which starts a variety of trouble, some of which finally becomes serious. In growing dentures in which permanent teeth are missing for any cause and the individual is too young for a permanent restoration, a temporary space retainer will maintain the normal space until such time as the permanent restoration can be made properly. In very young dentures, the importance of space retention as a preventive measure against malocclusion should require little argument in recognition of the two important functions of the deciduous teeth, namely, mastication and growth of the jaws, the latter being quite as important as, if not more important than, the former.

The performance of space retention is usually so simple, so inexpensive as to materials required and time consumed in their construction and application, that it is a pity to overlook this very important and many times neglected obligation to patients.

When making a case analysis, if one is able to determine those cases which are sure to be the cause of trouble, if retention is not established, the problem is simple. If one is uncertain, space retention can do no harm if properly employed, and it may prevent unfortunate consequences.

WOMEN IN DENTISTRY—1855-1880*

History is the essence of innumerable biographies.—*Carlyle.*

THE pioneer women in dentistry were individuals whose force of character compels our interest and arouses our admiration. The stories of their lives stimulate our enthusiasm for our calling and quicken our perception of the opportunities open to us today. To them and to those who aided and supported them in this and in other fields of human endeavor, the generations of today owe their privileges of education and occupation in their chosen profession.

It is well for the women dentists of our time to pause long enough in their busy lives to review the history of dentistry, especially as it relates to the early women practitioners. A new consciousness of their relationship to both the past and the future of the profession will result from the acquisition of this knowledge.

Medicine has its Elizabeth Blackwell; nursing, its Florence Nightingale; and dentistry has its Lucy Hobbs and Henriette Hirschfeld.

In 1820 and 1821, there were published in London the first and second editions of a book entitled, the "Natural History of the Teeth," by Levi S. Parmly. "In the first edition he offers to instruct gentlemen of liberal education for dental practice; while in the second the offer is extended to both ladies and gentlemen—where we probably have the earliest vision of the lady dentist."[1]

Who the "ladies" were that availed themselves of the opportunity thus offered is a matter to be discovered. The census reports of both Great Britain and the United States of these early days give no help, for not until 1870, when twenty-four women were listed as dentists in the United States, and 1871, when 116 women were listed in the British census reports, were the occupations and the sexes classified. Of the 116 women classified as dentists in Great Britain, sixty-three were under the age of 20 years.

Probably the first woman to establish herself in the regular practice of dentistry in the United States of whom much is now known was Emeline Roberts Jones of Connecticut. Mrs. Jones, after her marriage in 1854, at the age of 17, to Dr. Daniel Albion Jones, a dentist, "became intensely interested in her husband's work and developed a strong desire to assist him in practice. She went about accomplishing her desire very quietly, watching her husband work, and filling extracted teeth . . . until she had filled a two-quart jar with them. She then showed him what she had done, and after that it was an easy matter to convince him that she would be a valuable assistant. There were no colleges

*Prepared by the Committee on Historical Research of the Federation of American Women Dentists.

*Read at the sixth annual meeting of the Federation of American Women Dentists, Detroit, Michigan, October 24, 1927.

1. Brown, L. P.: The Greatest Dental Family, Dent. Cosmos, 45: 251 (March), 363 (April), 482 (May) 1923.

in those early days where a woman could study dentistry, but wishing to have a scientific as well as a practical knowledge of the profession, Mrs. Jones studied anatomy and the other subjects necessary to a complete scientific foundation, at the same time receiving instruction in the practical side of the work from her husband and from Dr. R. B. Curtis, a leading dentist of Winsted, Connecticut.

"In May, 1855 . . . in Danielsonville, Connecticut . . . Mrs. Jones commenced regular practice as her husband's assistant, continuing as such until 1859 when she became a partner in the business . . . enjoying a reputation . . . as a skillful dentist. In 1864, her husband died, leaving a son three and a half years old and a daughter six years old, and it was at this time that Mrs. Jones stepped into the front ranks of the business, carrying it on independently. In 1876, in order to give her son better educational advantages, Dr. Jones became a resident of New Haven, Connecticut. She was no less successful in her new field of work, where she enjoyed one of the largest and most remunerative practices in Connecticut. . . . For sixty years, Dr. Jones was actively engaged in her profession, retaining the eyesight, steady nerve and physical endurance demanded of a dentist up to her seventy-eighth year."[2]

At the meeting of the Woman's Dental Association of the United States in 1893, in Chicago, at the time of the World's Columbian Dental Congress, "certificates were read showing that Mrs. E. R. Jones had, prior to 1859, assisted her husband in his dental practice, and had continued it after his death."[3]

2. Street, Emeline A.: Emeline Roberts Jones, Pioneer Woman Dentist, Dent. Cosmos, 65: 991 (Sept.) 1923.

3. Footnote 2, p. 992.

In 1896, Dr. James McManus stated, "Mrs. Dr. Jones ranks today as the pioneer woman dentist of this country if not of the world. There may have been other women who assisted in dental offices previous to 1855, but she was the first woman in the country to open independently an office and offer her services to the public as a competent dentist."[4]

Fig. 1.—Lucy B. Hobbs, D.D.S. (From a photograph in the possession of H. T. Smith, Cincinnati, Ohio.)

A letter from her son, Dr. Daniel A. Jones, states that "she was elected to membership in the Connecticut State Society in 1893 and the recognition of her priority in practice, although very late, finally came in the form of an honorary membership in 1912 in the Connecticut Dental Society—and in 1914 a complimentary membership which amounted to

4. McManus, James: Record of Connecticut Dentists (Pamphlet published in 1896).

an honorary membership in the National Society."

In 1893, she was appointed a member of the Woman's Advisory Council of the World's Columbian Dental Congress.[5]

Emeline Roberts Jones died in 1916 at the age of 80.

The first woman in the world to be graduated from a dental college was Lucy B. Hobbs. Unlike Emeline Roberts Jones, Lucy Hobbs faced hardship almost from the time she was born in Ellenberg, New York, in 1833, until she had thoroughly established herself in dental practice in McGregor, Iowa.

"At the age of nine she was thrown upon her own resources. She struggled along getting what education she could."[6] She determined to study dentistry, at which time she must have faced as great difficulties as at any time in her eventful career.

In the autumn of 1859, Lucy B. Hobbs began making her attempts to secure the student training in the office of a dentist which was at that time a necessary preliminary to a dental college course. In her search for a place to study, she went from office to office until nearly every office in Cincinnati, Ohio, was "besieged." In a paper read in 1893, but apparently never published, on "Early Women in Dentistry," she describes the attitude assumed by most people of that day toward such an innovation as a woman dental student. "People were amazed when they learned that a young girl had so far forgotten her womanhood as to want to study dentistry. After a lapse of almost thirty-five years, it is impossible to give a just conception of the bitter opposition and the foolish objections that Lucy Hobbs had to meet and overcome. The main objection was that her place was at home, taking care of the house. They forgot . . . that she had no home . . . and that was the main reason why she wanted to learn dentistry. Some of the dentists to whom she applied for the opportunity to study in their offices were afraid their characters would be ruined if it was known that they had a lady student," forgetting that nine-tenths of their patrons were women. One was kind enough to propose to let her come and clean his office and look on while he worked, if she would not let anyone know that she was learning. She indignantly refused. . . . At last, she was successful. Dr. Samuel Wardle gave her a place in his office on the same footing as other students. . . . Her description of the days which followed her entrance into Dr. Wardle's office depicts with frank simplicity the hardships which she endured.

"No pen can portray the toil and privation of the next few months. In a little attic room, the nights were spent with a needle, earning a few pennies for the morning meal; the days incessantly toiling at a new and strange task. A previous study of medicine made the *study* easy, but there was much *hard work* connected with an office experience. It required all her Yankee perseverance and pluck not to give up. Days, weeks and months rolled on. She was prepared for college. In March, 1861, she made application to the Ohio Dental College for admission. Such boldness in a woman shocked the professors of so respectable an institution. Of course they refused.

"Dr. Wardle advised her to commence practice without a diploma, as a large majority of the male practitioners of that time were not graduates. She was

5. Tr. World's Columbian Dent. Cong., 2: 1036, 1893.

6 Lucy B. Taylor obituary, Dent. Cosmos, 52: 1315 (Nov.) 1910.

thwarted but not defeated, for she then fully determined never to rest until the dental colleges were open to women. She opened an office in a room in a little plain building on 4th Street, Cincinnati, Ohio. She was of good courage even

Fig. 2.—Helene Vongl de Swiderska, D.D.S. (From Harper's Bazar.)

though the pittance left after rent was paid was very meager . . . only twenty-five cents per week at times kept her from starvation.

"The war commenced that April. Business was paralyzed. A penniless girl could not live where old practitioners failed. She went to northern Iowa. A friend helped her to money to pay her fare. She opened an office. Many called from curiosity. Little by little her practice increased. The first year she made her expenses and the one hundred dollars which paid for her dental chair. The beginning of the second year found her equipped for her business.

"There are passages in all lives where it would be well if the books were closed. Words can never explain the heartaches. Such a one is the lone fight of a young girl against the whole world. Justice comes so slowly.

"With the same steadfast purpose, she pushed on. The second year brought reward, as the world reckons it. From that time on the sky was brighter. Her reputation widened until all Iowa knew of the *woman that pulled teeth*."[7]

In July, 1865, the Iowa State Dental Society convened in Dubuque for its fourth meeting. To this meeting, Miss Lucy B. Hobbs of McGregor, Iowa, was invited by its president, Dr. L. C. Ingersol. She accepted the invitation, attended the meeting and was elected to active membership.

"It is believed that this was the first instance of a woman entering as a member of a state dental society. The Society passed a chivalrous resolution in thus admitting women to full membership in the organized profession."[8]

"Then," wrote Lucy Hobbs Taylor, "the battle began in earnest. The woman dentist and her well filled purse and the State of Iowa to back her was a different

7. Taylor, Lucy B. Hobbs: Early Women in Dentistry (copy on file with Kansas State Historical Society).

8. Cooke, T. F.: Iowa State Dental Society, in Koch, R. E.: History of Dental Surgery, Vol. 2, Chicago: National Art Publishing Company, 1909, p. 905.

person from the penniless girl with an over-weening ambition to do men's work. She was sent with the Iowa delegates to the American Dentists Convention assembled at Chicago and there met the professors from the different colleges. The Iowa dentists made a formal demand for her admission to college, supported by a threat to withdraw the influence of the state from the one that refused it. The Ohio Dental College granted the request and she entered the same fall.

"Many misgivings were felt by her women friends, who feared she could not stand the strain, but she went through with credit to herself and womankind."[7]

She was graduated from the Ohio College of Dental Surgery in Cincinnati, Ohio, Feb. 21, 1866, having been required to attend only one college session because of credits allowed on account of her previous years of practice. The following announcement relative to the graduating exercises appeared in the *Dental Register* of that year: "The President of the Board of Trustees conferred the degree of D.D.S. on the following named gentlemen: viz., J. P. Collins, W. H. Pabodi, M. Stout, Miss L. B. Hobbs," etc.[9]

No comment was here made relative to the fact that, for the first time, a woman had received from a dental college a diploma conferring on her the degree of doctor of dental surgery.

The dean of the college, Dr. Jonathan Taft, wrote of her that she was "a woman of great energy and perseverance, studious in her habits (missing but one lecture during the session and that at the request of the professor of anatomy), modest and unassuming in her manners. She had the respect and kind regard of every member of the class and faculty. . . . As an operator in the clinic room, she was not surpassed by her associates, and often by them was both her opinion and assistance sought in difficult cases. . . . In the final examinations, she had no superior. . . . The class of which she was a member, though one of the largest ever in attendance, excelled all previous ones in good order and decorum, a condition largely due to the presence of the lady."[10]

"At the meeting of the Iowa State Dental Society in July, 1866," states Dr. Henry C. Chase, "she said to me, 'Had it not been for your influence, I should never have been admitted to the Ohio Dental College.' She meant the influence of the society, I suppose, in making her a member."[11]

Dr. Hobbs opened an office in Chicago following her graduation, and there, in April of 1867, married James M. Taylor, a veteran of the Civil War. The couple moved to Lawrence, Kan., that same year, and there "Dr. Taylor continued her practice even after her husband's death in 1886."[6]

It is reported that her husband studied dentistry under her and practiced with her.

Lucy Hobbs Taylor's name appears on the list of members of the Woman's Advisory Council, World's Columbian Dental Congress, which was held in Chicago in 1893.[5]

"Dr. Taylor was a woman of great mental force, and until she became physically unable, was an active member of several patriotic orders. She died at

9. Commencement exercises, Dent. Reg., 20: 145, 1866.

10. Women in Dentistry, Dent. Reg., 31: 100-105, 1877.

11. Chase, H. C.: Early Practice of Dentistry in Iowa, Tr. Iowa State Dent. Soc., 1888, p. 100.

her home in Lawrence, Kansas, on October 3, 1910, in her seventy-eighth year."[6]

The Ohio College of Dental Surgery at Cincinnati was the first dental college to grant the D.D.S. degree to a woman, but the Pennsylvania College of Dental Surgery was the first to matriculate a woman as a regular dental student for the entire two year's course.

In the year 1867, Henriette Hirschfeld of Berlin, Germany, arrived in Philadelphia alone and unknown, with the definite intention of studying dentistry in the Pennsylvania College of Dental Surgery. After the dean had refused to matriculate her, she appealed from his decision to the faculty. Then she visited that staunch and greatly needed friend of the pioneer woman in dentistry, Dr. James Truman. In his interesting article on the life of Henriette Hirschfeld, Dr. Truman states that, in carrying out her wish to study dentistry in a dental college, which was to be found nowhere except in America, "she not only had to face heavy expense to secure what she sought, but she well knew that in no country would women be willingly accepted as students in the colleges. She had also to contend with a language of which she knew little or nothing. None of these obstacles were, however, sufficient to change her purpose or discourage her determined spirit. She had, after careful consideration, decided to study dentistry and make it her life work, and having settled this, she had to meet the other difficulties with a brave heart—and this was her natural possession." He tells how "the faculty received her application with no pleasant feelings," how one member of the faculty "promptly stated that he would not teach anatomy to a woman," and how this decision seemed "to place a bar to her reception" until the objection was met by the proposal that "she take her anatomy in the Woman's Medical College of Philadelphia."[12] This arrangement seemed to eliminate an obstacle, "but it was only after much deliberation and many misgivings as to the result, on the part of a number of professors, that she was admitted upon an equality with the male students. Nor did this objection arise so much from the objection to ladies studying dentistry, as from the fact of its being an innovation, and the unwillingness to meet the embarrassments that *might* arise from educating the sexes together. Before her college course had terminated, however, she had by her womanly bearing, and professional skill, won from the faculty and her classmates, a full recognition of her worth;

Fig. 3.—Emeline Roberts Jones. (From Dental Cosmos.)

12. Truman, James: Henriette Hirschfeld (Tiburtius), D. D. S., and the Women Dentists of 1866-1873, Dent. Cosmos, 53: 1380-1386 (Dec.) 1911.

and the united testimony of all was that at no previous session had good order prevailed to such an extent, or the standard of clinical operations been higher.

"The quiet and gentlemanly bearing of the male members of the class during her presence in the school was in such contrast with the boisterous and rowdy spirit for which the medical students of Philadelphia have been so notorious that it was observed by all visiting the college."[10]

Before coming to America, she had made sure that she would be permitted to practice in Germany. "She had first to secure the consent of the Prussian minister—for, without this, practice would be impossible. Mrs. Hirschfeld's arguments, after repeated visits to the authorities, silenced all objections, and she was given a written promise that she would be allowed to practice dentistry in Berlin, provided she brought with her a certificate from a good and well-known American college."[12]

She was granted her degree, Feb. 27, 1869, and in making its report of the graduation exercises, the faculty made this statement:

"It will be observed that amongst the list of graduates occurs the name of a lady, Mme. Henriette Hirschfeld. As this is an innovation on established usage, it seems proper to state that in every particular she performed all the duties required of a student, and was enabled to equal the other graduates in all departments, fully justifying the belief of some, that success in our profession is not and cannot be limited to sex. This lady returns to Berlin, Prussia, to practice her profession."[13]

Dr. Fanny Tiburtius, who later became her sister-in-law, thus described Dr. Hirschfeld's advent in Berlin after her graduation:

"Berlin experienced a strange sensation in the year 1869, as the first female German dentist opened her atelier, and behold! she was not in man's clothing, she did not smoke, and she was not what the world called 'emancipated.' She was young (thirty-two) elegant and pretty, at the same time intelligent, quick at repartee, original and accustomed to good society, and at any rate one could go to her without losing caste.

"Ladies of the best society first sent their maids and servants, and then having questioned them, let their children follow, and then themselves brought up the rear. Soon the crown princess engaged Mrs. Hirschfeld for her nursery, and then her position was assured . . ."[12]

The following extracts from a letter written by Dr. Hirschfeld to an inquiring friend give, in her own words, her reasons for selecting dentistry as her life's work. They also answer the question as to the success she was experiencing in practice. She wrote "Frequent suffering in my own teeth, and while in the dental chair, without much relief, created the wish in my heart to understand the thing myself, and vanished when I had, very young, to be the head of a very large country household. After being left a widow and thrown upon my own resources, I looked to see how women supported themselves. I saw how they were shut out from many occupations suited to their sex and abilities, and how they had to work for a trifle, or how ill they were treated because the few places open to them were overfilled. Fully convinced that this state of affairs had to be changed in many respects, I concluded to do my part in taking up and carrying out my old favorite idea;

13. Commencement exercises, Dent. Times, 6: 175, 1869.

so I came to Philadelphia with full confidence in the liberal minded Americans.

"Thanks be to heaven! I have not been mistaken in my people, nor in the wants of my time. It is now nine months since I opened my office, and my success has far exceeded my expectations. Nearly half of my patients belong to our aristocracy, and two of the royal princesses are among them. . . . The journals have spread my history over the continent, and from all parts of the country I receive letters of thanks and encouragement. . . . Mothers are delighted that I take especial care for children, and they place their little ones with confidence under my charge.

"I don't think many of my professional brethren like it much that the females have crept into their privileges, but I can't help the poor fellows, they will have to get used to it.

"I am anxious to see the first female physician located here; the public mind is sufficiently prepared for it, and I am working for our cause daily."[10]

In the winter of 1872, she married Dr. Med. Tiburtius, an upper staff surgeon. Two sons came to the couple, one of whom became an engineer and the other a surgeon in the navy.[12]

In 1874, Dr. Hirschfeld, "whose business was larger than she could possibly attend to," took Dr. Louise Jacoby into partnership with her.[14] Dr. Jacoby was that year a graduate of the Baltimore College of Dental Surgery.

While a dental student, Mrs. Hirschfeld translated from the German several articles by French and German authors which were then published in the *Dental Times*. In the *Dental Cosmos* of 1873, she is also listed as a contributor.

In 1893, she came to the United States to attend the World's Columbian Dental Congress. She was one of the forty-one women dentists selected to serve on the Woman's Advisory Council of the World's Columbian Dental Congress in company with Emeline Roberts Jones and Lucy Hobbs Taylor.[5]

It is not possible to follow this remarkable woman through all her social life. It was ever a full one, and, as her sister-in-law writes:

"The farther she advanced in her career the more attention she gave to universal philanthropy, and for this purpose started various *vereins* (associations) for the welfare of the general public. She established a clinic for women with Dr. Fannie Tiburtius as one of the two physicians in charge, and also a hospital for women. Age began at last to tell on this energetic life, and she passed her practice over to her niece in 1899, and retired to her villa in Marienfelde, near Berlin. Here she remained constantly active in benevolent work for the elevation of her sex until her death, August 24, 1911.

"Thus passed away, in her seventy-seventh year, one of the most brilliant women dentistry ever enlisted in its service, leaving a name long to be remembered in the social life of Berlin and in the ranks of her profession."[12]

The third woman to be graduated from a dental college was Countess Hélène Vongl de Swiderska of St. Petersburg, Russia, who received her diploma from the New York College of Dental Surgery on March 4, 1872.[15] She attended only one college session, having received credit for previous study.

It is evident from two articles which appeared shortly after her graduation

14. Women Dentists in Germany, in Johnston's Dental Miscellany, 1874, p. 239.

15. Records of the New York College of Dental Surgery.

that she too, at that time, was thought to be the "first of her sex entitled to affix the professional D.D.S. to her name."[16] Evidently, no Associated Press dispatches had announced to the readers of the world's news that two others had preceded her! In her country, she must have been as much a pioneer as Lucy B. Hobbs and Henriette Hirschfeld were in theirs. Her background was different from theirs, but definiteness of purpose, courage, perseverance and energy were characteristic of all three of them.

As regards her early life and the circumstances which led to her determination to study dentistry, the following extracts from an article published in *Harper's Bazar* are interesting.

"Madame de Swiderska's career has been singularly adventurous and interesting. She is a native of Lithuania, in Russia. She lost her mother at an early age, when her father, an eminent physician of St. Petersburg . . . devoted himself to her education, and trained her to habits of scientific study far more serious than is common with young girls in Russia. At the age of sixteen, she married the Count de Swiderska, a member of the high nobility, who held an office under government; but who had little fortune wherewith to support his title. She became the mother of a son in whom all her hopes were centered, and for whom she resolved to create a fortune to supplement the rank bestowed upon him by his father. Moreover, she had long felt the need of an earnest occupation. Impelled, doubtless, by inherited proclivities—her uncle, brothers, and father were all physicians—she now determined to devote herself to some specialty of medicine and on looking about found none so available as dentistry, which is almost unknown in Russia, and indeed, throughout Europe, though the field for it is so great. She therefore made the preliminary studies in medicine under her father's direction and, after obtaining all the dental knowledge that could be gained in St. Petersberg, set out for Berlin, furnished with letters of recommendation from distinguished personages. What was her disappointment on learning that dentistry was even at a lower ebb in Berlin than at St. Petersberg, that nowhere in Europe could she hope to extend her knowledge, and that to perfect herself in the science she must go to America, finish her studies in a college, and obtain the necessary diploma! But here another difficulty arose; the American colleges did not admit women. Nevertheless, she determined to go thither, believing that to a resolute will nothing is impossible. She arranged her affairs in two days, and armed with letters of introduction arrived at New York."

From the Grand Duke Alexis, whom she went to see in Boston immediately after her landing, she secured an additional letter of recommendation, and returned to New York.

"When we think that she had not a friend nor even an acquaintance in America and that she had to rely solely on herself in every emergency, we can imagine the force of character that was needed thus to overcome all obstacles in a strange land.

"Armed with her credentials, Madame de Swiderska at last presented herself for admission to the College of Dental Surgery, and though at first refused, was finally suffered to enter as a special favor, with a pledge that she would claim no immunity from duty on account of her sex. It was found that her preparatory studies were equivalent to two

16. The First Lady Doctor of Dental Surgery, Harper's Bazar, June 22, 1872, p. 417.

years of the collegiate course. She applied herself assiduously, rising at seven and studying till midnight daily, though she was greatly hampered by her imperfect knowledge of English, the first lectures being, as she says, Greek to her. With the proverbial linguistic quickness of the Slavs, she mastered the language in three weeks, so as to understand it readily. Thenceforth she made rapid progress, passed a creditable examination, and received the diploma of Doctor of Dental Surgery.

"Having attained her goal, Madame de Swiderska determined to see something of America and the Americans before her return. She was warmly urged to remain and practice her profession in America, but irresistible attractions drew her homeward, to St. Petersberg, there to enter upon her professional career.

"Madame de Swiderska is about 25 years old, and is singularly graceful and polished in manners. She has the tall, lithe figure so common to the Russians, with a brilliant complexion, sensitive mouth, deep violet eyes, and magnificent brown hair, whose luxuriance might well entitle her to the appellation of *la dame Russe aux longues tresses,* by which she was known on the ship on her way hither. We wish her all success in her career, and hope that she may realize her desire of being a useful worker without ceasing to be a wife and mother worthy of the name, and of sharing in the burdens of life, and teaching her fellow-countrymen that the true emancipation of women is not the emancipation from the duties and tasks of life, but rather the participation in its burdens and responsibilities."[16]

Evidently, the editor of the *British Journal of Dental Science* was won over to an admission that a dental education was not always "incompatible with lady-like manners and feminine grace," for he wrote: From the August issue [of *Chemist and Druggist*] we reprint the following excellent account of a lady dental practitioner whose acquaintance we recently had the pleasure of making. Although by no means advocates for female medical or dental educations, it is impossible, after knowing this lady, not to admit that thorough professional acquirements are not, in some cases at least, incompatible with lady-like manners and feminine grace.

"The Countess Hélène Vongl de Swiderska was in London quite recently en route from New York to St. Petersberg."[17]

The name of Dr. Swiderska appears in the list of the Woman's Advisory Council of the World's Columbian Dental Congress in 1893. She came to America in this year to attend the Congress.

The graduation of the fourth woman dentist in the person of Frau Marie Grubert of Berlin, from the Ohio College of Dental Surgery, March 6, 1872, marks another epoch in the history of women in dentistry, that is, the first election of a woman to office in a dental society. An editorial on the "Ohio Dental College" has this to say of her.

"This is the second instance in which the degree of D.D.S. has been conferred upon a lady by this institution, and our experience in this direction is thus far very gratifying indeed. Both stood very well in their respective classes, and both were great favorites with their classmates and with the faculty. The former has been since her graduation, six years in very successful practice.

"The latter, Mrs. Grubert, by her courteous manner, dignified bearing, and professional ability, commanded the re-

17. Brit. J. Dent. Sc., 15: 472, 1872.

gard and esteem of all who became acquainted with her. In the Mississippi Valley Dental Society, she received such consideration as has never been bestowed upon a lady before; after being elected to active membership, she was unanimously elected its vice president. The independence, energy, industry and perseverance which she manifested in the pursuit of her professional studies were most praiseworthy. She became one of the best operators in her class.

"She returns to her native city to enter upon a very promising field of professional labor which is to be confined to ladies and children. Many and urgent were the solicitations she had to remain here; and we have no doubt she would at once have entered upon a large and lucrative practice."[18]

Not only did the Mississippi Valley Dental Society elect her to the office of vice president, but "her name was also referred to the Committee appointed . . . for a letter of recognition and compliments from the society."[19]

The election of Lucy B. Hobbs to active membership in the Iowa State Dental Society seems to have been the event which caused George T. Barker, D.D.S., one of the editors of the *Dental Times* to publish in July, 1865, an article on "Dental Surgery—Should Females Practice It?" in opposition to the entrance of women into the profession of dentistry. His arguments were that "the two most prominent requisites" which he considered "imperatively necessary for persons to possess to enable them to successfully practice dentistry" were "a mental and physical equipment of a high order," because, "the practice of dentistry is calculated to undermine the very best balanced constitutions." "The cause of this," he said, "is due to the double demand which is made simultaneously both upon the mental and physical powers." Then he notes, in support of his theory, how few "old practitioners, say of twenty-five or thirty years' practice, are present" at the conventions; "and if they are, how many of them complain of loss of eyesight, dyspepsia and indigestion."

Then he asks, "Should females be encouraged to enter the dental profession? I contend they should not, and it is with no disrespect that the assertion is made. The same reason holds good against females practicing dentistry that it does against a feeble male, for the reasons as previously stated. The very form and structure of woman unfit her for its duties. Again, I contend that its performance would, under certain circumstances, be attended with great danger. One of these circumstances may be cited; as, for instance, in pregnancy. Who would encourage a female to perform a trying and difficult operation at such a time, and must not a woman neglect her family for the performance of dental practice? . . . That the sphere of woman's usefulness should be extended I, for one, justly urge; that she is now debarred from entering many occupations for which she is fitted, I allow; but to me it seems dentistry is not one of the class of occupations for which she is fitted physically, though she is mentally, and it is with regret that the statement is made; for were we only to have some of the mental energy of women infused in our profession, it would stimulate some of its members doubtless to increased activity, particularly in the science of dentistry. . . . I will admit that women can, by cultivation, develop

18. Ohio Dental College, Editorial, Dent. Reg., 26: 136, 1872.

19. Proc. Mississippi Valley Dent. Soc., 1872, in Dent. Reg., 26: 213-214.

either the mental or physical energies to a degree equal to man; but that she was, by an all-wise Providence, fitted or designed for great physical labor, I deny, or, for what is more trying, a development to a great degree of both simultaneously.

"My views on this subject have been called forth by the election to membership of females in some of our Western Dental Associations, and by the views promulgated by certain prominent practitioners and writers. Impressed with the truth of this position, I propose to offer an amendment to the Constitution of the American Dental Association, at its next meeting in Boston, to allow none but males to be eligible as delegates from local societies."[20]

No record of the presentation of this proposed amendment to the Constitution of the American Dental Association has been found.

In response to this article by George T. Barker and in defense of women as dentists, the editor of the *Dental Register* published in 1866 an editorial under the caption, "Ho! Every One to the Breeches!!" in which he said:

"A little boy was chased by a cross dog. 'Weren't you frightened, Charlie?' asked a friend.

" 'Well no, Uncle; I wasn't scared, but I never wanted up a tree so badly in all my life,' said Charlie.

"Well, what of it? Why—

"The 'G. T. B.' editor of the *Dental Times* isn't exactly frightened; but since the day that his mother spanked him he has not had such misgivings in reference to the encroachments of woman upon the rights of man. And the primary cause of this turmoil is a little girl out west who has gone and made a dentist of herself; and the finishing stroke is that she has been admitted to membership in a first class State Society; and, as if adding insult to injury, she has graduated in the Ohio College of Dental Surgery, and is, therefore, Lucy B. Hobbs, Doctor of Dental Surgery, which is something not provided for by the customs of society nor even laid down in the books.

"But what is 'G. T. B.' going to do about it? That is the funniest of all. He tells us 'I propose to offer an amendment to the constitution of the American Dental Association, at its next meeting in Boston, to allow none but males to be eligible as delegates from the local societies.'

"G(o) T(o) B(rother)! Let me expound unto you 'a more excellent way.' If Doctor Lucy should be at Boston as a delegate, before you offer your amendment, get her to fill a tooth for you (if you have no decayed ones let her drill a hole in a sound one) and your objections to lady dentists will vanish into thin air. The doctor will do it well. The Ohio College will go her security; and it will appear so perfectly natural and proper to the patient that his amendment will never be thought of again. When there is but one lady graduate in the whole dental profession of the world, it looks like taking time by the fore-lock to shut her out.

"The editor argues at length that woman is not fitted by nature for the practice of dentistry. I do not propose to notice his arguments; they are average specimens of special pleading. Their main point seems to be that, as the practice occupies both mind and body, it is too hard for women. Filling a tooth requires less effort of mind and body than getting up a dinner; and the whole of dental practice is mere play, both of

20. Barker, G. T.: Dental Surgery—Should Females Practice It? Dent. Times, 3: 152-155, 1865.

mind and body, when compared with housekeeping."[21]

Miss L. Jenny Kellogg, of Minnesota, also came to the rescue of women as dentists, in reply to Dr. Barker. She said: "The doctor says: '. . . the very form and structures of woman unfit her for its duties'; referring to the practice of dentistry. This I most emphatically deny, and think it would puzzle anyone to prove it.

"He also dwells upon the great danger attendant upon the practice of dentistry during pregnancy and nursing, as well as the neglect of the family, which he seems to think must inevitably follow. So far as the neglect of family is concerned, that cannot affect unmarried ladies, and I am personally acquainted with several such, so I know they do exist. He says: '. . . that she is now debarred from entering many occupations for which she is fitted, I allow, but to me it seems that dentistry is not one of that class for which she is fitted physically, though she may be mentally', etc. So here is a bolt to be slipped, a bar to be put up, if the doctor can accomplish it to keep her out of the profession. We look around—someone else has put a hedge in another place. A third person has raised an objection at some other point, and so we find ourselves barried and hedged in. Now, to each and every one of these men, I would like to ask: 'How long do you propose to define woman's position for her? . . . They imagine that she needs bars and bolts, laws and prohibitions made expressly for her, or she would fly off into all sorts of unwomanly things. Never was there a greater mistake. . . . She will make no protracted effort to secure and hold a position for which nature has unfitted her. . . . And I do most earnestly question the right of *propriety* of any body of men deciding what her sphere shall or shall not be."[22]

In between the appearance of the opposition article by the editor of the *Dental Times,* Dr. Barker, and the defense editorial by Dr. Walsh of the *Dental Register* came the clear and stirring reference to women and their fitness to practice dentistry in the valedictory address delivered by Dr. James Truman, in March, 1866, to the graduating class of the Pennsylvania College of Dental Surgery. It is evident that this paragraph, relating to women and dentistry, was inspired by long and painstaking thought on the subject of the inherent right of all persons, regardless of sex, to the opportunity to undertake studies and follow occupations for which they feel themselves qualified.

An audience of about 2,000 people, including the faculty and the graduating class of the Pennsylvania College, heard the valedictory address, from which the ensuing extract is taken:

"The recognition of the right of every human being to an equal share in the privileges that we enjoy has not yet become a principle of faith and practice, as I think it should. We say to one-half of the human family, stitch, stitch, darn stockings, make shoes for a shilling, stand behind counters for two or three dollars per week, do anything, but don't enter the sacred precincts that we have marked out for our peculiar benefit. Every human soul has certain qualities; those qualities should mark its pathway through life. Talent is of no sex, color or clime, but it is an inheritance from the Creator, given to be fully cultivated in the direction that it leads; hence, in my judgment, any attempt to cripple the

21. Ho! Everyone to the Breeches! Editorial, Dent. Reg., 20: 374-375, 1866.

22. Kellogg, L. Jenny: Dental Surgery—Should Females Practice It? Dent. Times, 4: 54-56, 1866.

aspiration of a God-implanted intelligence is unworthy the age in which we live, and is little short of blasphemy against the Creator himself. As we keep any number of the human race in a condition lower than ourselves, just in that proportion will the degradation be a millstone around our necks; the reverse of the proposition is also true. As we advance the masses in intelligence, and the means of acquiring information and pecuniary rewards for labor, will the civilization of all be increased. Hence, as an individual, I welcome all classes to the profession of which I am a member, and should make but *one* requirement—do you feel that you are *qualified* for it, and would do better in it than in any other position in life? Entertaining these views, I rejoice that dentistry has, though the youngest of the professions, welcomed woman, in two of our state organizations, to full membership, and has recognized her as a co-laborer in a field full of interest, and one in which, to my judgment, she is well adapted. It may be that I stand alone in these views, both with the faculty and the audience; but I trust not, as, in my judgment, the advancement of the world depends, to a large extent, upon their adoption. But the number who are willing to sustain them is of small moment; the question to be considered is, *are they true?* Has not every parent who has failed to give his or her daughter a knowledge of some trade or profession neglected one of the plainest requirements of life? Certainly. The world is full of misery on that account. I am sick of the cant and hypocrisy that would prevent women doing anything to earn her daily bread, and calls it a dispensation of Providence when that woman is left with a family to support, by toiling her days and nights away over the needle. Let your daughter enter the professions, or anything she can earn a livelihood at, and I regard it as a dispensation of Providence that He has, in His wisdom, given that daughter brains enough to take a position in life higher than you may have been able to fill. The world is very slowly coming to an appreciation of this great truth; but it will grow, and become the belief of the nations in time, not in yours or mine, perhaps, but it will come; for 'the mills of the gods grind slow, but they grind sure!' "[23]

The courage which this statement required of its author in 1866 may be difficult for some of us today to comprehend, but some glimpse of the quality of that courage may be had by reference to the letter from Dr. Truman written in 1893, which is later quoted.

In 1869, at the ninth annual meeting of the American Dental Association held in Saratoga Springs, Dr. James Truman again showed his interest and demonstrated his support of women in the profession of dentistry by presenting, through the Secretary, the following resolution:

"WHEREAS, the recent action of two of the oldest colleges of dentistry in this country in admitting women to the full honors and duties of the profession renders it imperative upon this national delegated body to take some action in reference to their admission into full fellowship in the profession; therefore be it

"*Resolved,* that in view of the successful results obtained in the education of women as dentists, we recommend to subordinate associations to admit to full membership any woman duly qualified.

"*Resolved,* that in consultations, consideration of sex should be avoided;

23. Truman, James: Valedictory address, Dent. Times, 3: 161, 1866.

ability and moral character alone being the standard of judgment in all cases."

On motion, the resolution was laid on the table.[24]

The difficulties of securing a dental education by women were far from being over even after Lucy B. Hobbs, Henriette Hirschfeld, Hélène de Swiderska and Marie Grubert had secured their diplomas.

Dr. James Truman, in a letter addressed July 7, 1893, to Dr. Mary H. Stilwell, of Philadelphia, president of the Woman's Dental Association of the United States, tells of the struggles and efforts put forth to secure for women the continued right to be matriculated and graduated from dental colleges, and to be received into the profession. The letter is herewith presented through the courtesy of Dr. Mary H. Stilwell Kuesel:

> In response to your request that I should furnish you some of the facts connected with the entrance of women into dentistry, and agreeing with you that these should be placed on record for the instruction of those who may come after us, I give you the following facts:
>
> The entrance of women into medicine was a more thorny path than that to dentistry, yet it is doubtful if that pioneer work had not been done whether the latter could have been accomplished.
>
> The beginning of the last half of the present century found thought on this question of woman's progress but little further advanced than it had been in previous eras. It was no easy matter to uproot the prejudices of ages, and while great progress has been made, there is yet much to be done before all doors will be opened to women as freely as to men.
>
> The question of the appropriateness of dentistry to women had been long a fixed thought in my own mind until I conceived it to be a duty to attempt to open the way for her entrance into practice. As far as I am aware, no one had seemed to regard dental practice as possible for women. This was natural from the crude ideas prevalent regarding the work to be accomplished. It was peculiarly a man's work. With my observation and experience, I found it impossible to agree with this view, and maintained that above all the professions it was the one best fitted for her to follow.
>
> So impressed was I with this thought that I concluded to embody my views in a valedictory address I was expected to deliver in the spring of 1866, at Musical Fund Hall, Philadelphia, to the graduating class of the Pennsylvania College of Dental Surgery. It was with considerable trepidation that I adopted this course, as I appreciated the prejudices prevailing, and the more than possible antagonisms I would be called to meet, and the probable injury to myself, professionally and financially. The anxiety which these probabilities occasioned then can hardly be appreciated now, when a different state of affairs exist. The valedictory was delivered to some two thousand people, and although the paragraph containing the objectionable matter was brief, it was decided on the question of woman's fitness for dentistry, and expressed the hope that she would accept the opportunity.
>
> It is needless to dilate upon the impression this created. With the audience, it was probably regarded as the vagary of an enthusiast, but with the faculty as a whole, it was looked upon with mingled feelings of mortification and vindictiveness, which were not long allowed to slumber. From that time on, my professional path was not an agreeable one.
>
> At this period, 1866, there was no prospect of any woman coming forward to matriculate as a dental student; indeed, the general verdict was so in opposition to my own views that I could but regard it as not a probability of the then near future.
>
> My surprise was great, therefore, to have reported to me through the then dean of the Pennsylvania College of Dental Surgery, Dr. T. L. Buckingham, that a woman had applied for matriculation. This was in the fall of 1867. The applicant was informed that the college could not admit women. The matter came before the faculty when it was announced that this lady, Henriette Hirschfeld, of Berlin, had appealed from the decision of the dean to the faculty. The question of her admission, it may be surmised, created a warm and exciting de-

24. Tr. A. D. A., 1869, p. 23.

bate, ending finally in her rejection by a majority vote, two voting in her favor, Professors Harthorne and Truman.

In a subsequent interview, it was learned that she had left her native land with the full assurance that she would have no difficulty in "free America" in securing a dental education. She had also the positive promise of her government, through the then Minister of Instruction, Dr. Falk, that on condition of receiving an American diploma, she would be permitted to practice in Germany. Her distress, therefore, at this initial failure was naturally very great.

The excitement in the college was intense, and seems amusing now, after the lapse of twenty-five years, but was quite natural under the then existing feeling. This was intensified when it was learned that the dean had concluded to change his vote. This made a majority in her favor and admitted her to matriculation. The bitter opposition manifested by the professor of anatomy made it advisable for her to take these lectures at the Woman's Medical College for that winter.

The first lecture she attended in the dental college she was received with a storm of hisses. This was almost crushing to her, but this opposition entirely melted away as the months advanced, and the students not only came to respect her, but she became a special favorite with the entire class, who, while not convinced as to the propriety of women entering the practice of dentistry, were quite willing to make her an exception. The last year, the professor of anatomy yielded his objections, and she was permitted to take all her studies in the college.

At the meeting of the American Dental Association, held at Saratoga, 1869, I was in attendance as a Delegate, and it seemed to me an appropriate occasion to spread my views on this question of women in dentistry. I, therefore, prepared a general resolution welcoming women to its practice, and asked the endorsement of the Association. I supported this by a speech that, as I look back at it, must have startled the conservative element present not a little. The resolution was laid summarily on the table. This I expected, and as my only object was to stir the subject and have it brought out in the reports, the result was entirely satisfactory. That it had this effect I am confident, for there was a rapid increase of numbers favoring the entrance of women dating from this period. As far as its influence went, it served to crystallize thought in this direction.

The matriculation of Mrs. Hirschfeld was regarded by the faculty as simply an exceptional incident, and the majority refused to regard it as forming a basis of policy; hence, it was apparent that any future applications meant a renewal of the bitter contest made on the first application. Several applications for matriculation were made from women in Germany, but these were without hesitation denied.

Failing to convince my colleagues of the injustice of their course, I endeavored to secure more favorable results from other colleges, and I applied personally to Professor Gorgas, dean of the Baltimore College of Dental Surgery. The first applicant, subsequent to this decision, was a German lady, who being refused at the Pennsylvania College of Dental Surgery, was taken by myself to Baltimore and matriculated in the aforesaid school.

The loss of money began to tell on the pockets, if not the consciences, of the faculty of the Philadelphia school. They saw the stream had been diverted in another direction, swelling the coffers of a competing college. This led to a change, and it was concluded to repeat the first experiment in coeducation on the first opportunity.

This was soon forthcoming in the application of three women in 1872 and 1873: Miss Annie D. Ramborger, of Philadelphia; Fraulein Veleske Wilcke, and Fraulein Jacoby, of Germany. Their first year was very satisfactory, there being no opposition worth considering on the part of the students. At its close it was evident, however, that a small minority of the class had determined to effect, if possible, their dismissal. A petition to this effect was presented to the faculty. The majority of the students met this by a counter-memorial in their favor. This latter met with scant consideration by the majority of the faculty, who claimed to regard the former as representing more nearly public sentiment upon the question. It was, therefore, decided not to allow the women students to take another year at the college. Every effort was made to prevent this decision by myself in the faculty, but, being overruled, there was

nothing left but an appeal to the governing body, the board of trustees.

A special meeting of this body was called to consider this appeal on March 27, 1873. At this meeting, two communications were presented, one from the majority of the faculty and the other from myself. These were read and ordered filed. The matter was then referred to a committee consisting of Hon. Henry C. Carey, the noted writer on economic law; Hon. W. S. Peirce, Judge of the Court of Common Pleas, and G. R. Morehouse, M.D., a prominent physician of Philadelphia, all of them members of the board. A special meeting of the board was called to hear their report, March 31, 1873, at which the contending parties were invited.

The report was read, from which following abstracts are made:

"Three ladies entered as students of this college at the commencement of the session 1872-1873, paid their matriculation fees, attended the course of lectures, and were informed by a resolution adopted by a majority of the faculty at the close of the session that they would not be permitted to attend the second course of lectures. No other cause was assigned for the action of the faculty than that they deemed it against the interest of the college to permit them to do so, on account of the dissatisfaction which it gave to certain male students, etc. . . . The goal to which all medical and dental students look is graduation and the diploma, which is to be the evidence of their qualification to practice their art. To qualify themselves for this, they bestow their time, their money and their labor. To deprive them of this without just cause is to disappoint their hopes, and to receive from them money and bestowal of time and labor without the full equivalent which they had a right to expect."

After discussing at length the legal aspects of the case, the summing up is as follows: "We, therefore, respectfully report that in our opinion it is the legal right of these ladies to attend, and it is the legal right of this college to give them, as students, a second course of lectures on the terms of the announcement which forms the basis of the contract with them."

This report was signed by all the committee, and was written and read by Judge Peirce. It carried with it, therefore, all the force of a judicial decision, and was so accepted by the board as a whole, and at once adopted. This left the majority of the faculty no choice but to accept the decision as final as far as these students were concerned. That this result was unexpected and a bitter one, it is needless to say, while it was equally encouraging to the single contestant. Two of these ladies, Miss Ramborger and Miss Wilcke, accepted the decision and continued their studies in this school to completion. Miss Jacoby matriculated in Baltimore.

The most interesting feature connected with this matter, and which clearly demonstrated a marked advance in public opinion, was the stir it made in the press of the city. The daily and Sunday papers bristled with strong editorials, the faculty being denounced in no measured terms for their action. To such an extent was this carried, and so overwhelming was the indignation, that it practically settled the question for Philadelphia, although several years elapsed after these two were graduated before others were accepted.

When the time did arrive, under the present dean, Dr. C. N. Peirce, they were accepted without reservation, and the school has continued to receive women ever since.

The efforts thus made midst continued opposition through many years finally reached a point of settlement, and woman began to take her proper place in the profession of dentistry.

The college which first rejected and then accepted women students has now an average of seven to nine women yearly, about equally divided between America and Germany. The Philadelphia Dental College has a proportionate number. The Dental Department of the University of Pennsylvania has not, as yet, been converted to co-education, but this is through no fault of its faculty, it being in favor of the admission of women, but not possessing the controlling power, it is obliged to see, yearly, numbers of women applicants drifting to other schools.

The learned medical theories promulgated in the early days in regard to the injury likely to result to women in the practice of dentistry have all fallen to the ground. The advocates of this form of training were met continually with the health question, and as it had never been tested in practice, the most favorably inclined looked forward with some anxiety to the result. Twenty-five

years have elapsed since the first woman received the diploma in dentistry, and as far as known, every woman who received the degree at that period is yet in practice and with a degree of health quite equal to the average of the opposite sex. Almost every town in Germany has from one to two women, and they are being rapidly distributed over the towns and cities of America. I have yet to know of a single failure from physical deterioration. So much for learned homilies in advance of practical experience.

Miss Lucy B. Hobbs was the first lady to receive a degree in dentistry, graduating from the Cincinnati College of Dental Surgery. She is still, it is believed, in active practice in Kansas.

Mrs. Hirschfeld, before mentioned, the second graduate, created, perhaps, more sensation, as she became at once the target of the comic papers of Germany, and received more serious attention from the well-known periodicals, the *Bazar* and *Uber Land und Meer,* both of which contained elaborate and illustrated notices of her. She had friends in the higher walks of life in Germany, notably among these was President Lette, of the *Frauen Verein,* whose aid assisted her materially in her early struggles.

The result of these combined forces soon placed her in possession of a large practice. She was patronized by ladies in the highest circles, including the then crown princess. She subsequently married, had two boys to educate and a large household to supervise. She had assisted several of her relatives into the professions, two in medicine and two in dentistry, besides aiding many worthy persons. She established a clinic for women in Berlin, very badly needed there. This was in charge of two physicians, one being her sister-in-law, Dr. Fanny Tiburtius. She also established a hospital for women. These charities were, and I presume are still, mainly supported by her individual exertions. Notwithstanding all these multifarious and trying duties, she practices daily her profession, and is as well, physically and mentally, as when she commenced, and with her usual energy expects to take part in the World's Columbian Dental Congress, August 14, at Chicago.

Dentistry is probably one of the most trying professions, very few being equal to the severe strain. No woman, to my knowledge, has, as yet, failed, though it would not be at all remarkable were this to be the case.

The opening of this door to women was not accomplished without the usual martyrdom of all enthusiastic workers in a new field. It does not become me to enlarge upon this part of the work. Fortunately for women, the whole field of human labor is open to her today, and it is well, at this happy period of her liberation, to stop and review the work which led up to it and to record the history for the instruction of the present generation and those who may work in the future in our ranks.

It is with regret that I have been obliged to make my own personality so prominent, but as this was a single individual's work, it could scarcely be avoided.[25]

Some of the opposition, the prejudices and the defenses of which Dr. Truman speaks are further reflected in the following extracts from articles which appeared in several dental journals between the years 1873 and 1876.

"Among the matriculants [at the Baltimore College of Dental Surgery] are two ladies from the North German Empire, one of whom is now attending her second course, and will be a candidate for graduation in March next.

"The experiment of receiving female students, inaugurated last session, has proven so successful, and the effect upon the male students is so beneficial that the faculty are perfectly satisfied with their action in this respect.

"The greatest respect and consideration has, at all times, been shown by the male members of the class to these lady students, their behavior being such as to reflect honor upon themselves, and to merit the title of gentlemen."[26]

25. Truman, James: Entrance of Women Into Dentistry, 2d Ann Rep. Woman's Dent. Ass'n of U. S., 1893.

26. Baltimore College of Dental Surgery—Female Students, Am. J. Dent. Sc. (Series 3), 6: 429, 1873.

Regarding the first woman graduate of the Baltimore College of Dental Surgery, an editorial has this to say:

"The Baltimore College of Dental Surgery having had the honor of conferring the first degree of 'Doctor of Dental Surgery' in the world has also graduated the first of the female sex who ever received a diploma in medicine or dentistry in Baltimore, in the person of Miss Emilie Foeking, of Prussia, who, after attending two full courses of lectures and demonstrations, passed a very creditable final examination. Miss F. conformed to all the rules and regulations of the college during the two sessions she was a student, no favor whatever as to requirement being asked for on her part, or extended to her by the faculty on account of sex, and has fairly earned her degree by proficiency and application. After a short time, Miss F. will return to Berlin, where she intends to locate; and that she will succeed in establishing a large and lucrative practice, there can be no doubt, as she is well qualified professionally, and in manner so perfect a lady as to command the respect of all who know her."[27]

She it was who was refused matriculation at Pennsylvania College of Dental Surgery and was then taken by Dr. Truman to the Baltimore College of Dental Surgery, where she was admitted.

In 1873, in a prominent daily paper, we find the following under the heading "Woman's True Rights":

"The Pennsylvania Dental College of Philadelphia is in a state of great internal commotion, in consequence of the exclusion from the second course of three ladies who had been matriculated and attended the first course. The dissatisfaction of the male students threatened greatly to diminish their attendance, and the authorities thus yielded to the pecuniary exigencies of the case.

"Two of these ladies referred to in this communication have already matriculated in the Baltimore College of Dental Surgery for the session of 1873 and 1874, the faculty of this institution, from past experience, having no objection whatever to receiving female students.

"Why the male students of the Pennsylvania College should object to those of the opposite sex, we cannot understand, as it has been entirely different in the Baltimore College during the past two sessions, where respect and consideration, instead of enmity, have characterized the behavior of the male portion of the class toward the female members.

"We are not so uncharitable as to ascribe this opposition on the part of Northern students to a want of that courtesy and respect so justly woman's due, and which have been manifested by Southern dental students in the Baltimore College (where a great majority of the class are from the South), thereby maintaining their claim to be gentlemen, but rather to the fear on the part of the Northern men that perhaps their domain of practice is about to be invaded by the opposite sex."[28]

In at least one of the eastern dental societies, namely, what is now known as the First District Dental Society of New York, another courageous man in 1874 attempted to secure for women the same opportunities that men possessed in obtaining a college education in dentistry.

The following resolution was offered by J. S. Latimer, and seconded by Charles Miller:

"WHEREAS, it has come to our knowledge that some of the dental schools have

27. Editorial, Am. J. Dent. Sc. (Series 3), 6: 527, 1873.

28. Woman's True Rights, Am. J. Dent. Sc. (Series 3), 6: 574, 1873.

refused instruction to women because they are women; therefore

"*Resolved,* that we do hereby assure the said schools that, in our opinion, the better part of the dental profession in our country desire the thorough qualification of every practitioner of dentistry, without regard to the sex of that practitioner."

"Drs. Fitch and Abbott strenuously opposed the resolution, on the ground that women attending the surgical clinics and anatomical lectures in the same classes with young men are frequently shocked, mortified and abashed by the indecorous conduct of the male students. They desired the thorough education of women, and did not object to their pursuing any honorable calling, but believed they cauld be better taught in separate schools.

"J. S. Latimer defended the resolution, claiming that in lectures appropriate to dentistry pure-minded lecturers could say all that need be said without shocking the modesty of any. He furthermore stated that in the grammar schools it had been observed that in those attended by both sexes the conduct grade is much higher on account of the elevating and refining influence of the sexes upon each other.

"A motion to indefinitely postpone further consideration of the resolution was carried, Drs. Fitch and Abbott voting for and J. S. Latimer against the motion. No other members voting."[29]

To the women graduates of the Dental Department of the University of Michigan (the first woman to secure her D. D. S. degree having been graduated in 1880), the following from *Scribner's* of 1876 will prove especially interesting:

"Having been in happy operation for twenty-nine years as a university exclusively for men, in the year 1870 it opened its doors in all departments for the admission of women. . . . Michigan is the first university which, having begun its life and attained eminent success upon the old and exclusive system, then deliberately incorporated upon itself the new and more comprehensive plan. The resolution to do so was by no means a hasty one, or taken with much cheerfulness. It had been under consideration for twenty years and when adopted at last, it was adopted with no little anxiety. Our experience of five years has, I think, convinced everybody here that the anxiety was not well founded. Neither good order nor the scholarship of the university has suffered any harm from the presence of ladies in its classrooms; while the physical disasters to the women themselves, which an eminent medical authority has of late clearly demonstrated to be the penal consequences of feminine toil at the dry and arduous tasks of university study, have thus far strangely failed to make their appearance in this neighborhood. Indeed, the ladies here seem to thrive ludicrously well under the rugged regimen to which they have been put; and their omission to verify the predictions of an *a priori* alarm is something bordering upon the cruel. A benevolent mind observing these things can hardly do less than utter a word of kindly caution to all persons who still desire to take unalloyed comfort in the doctrine that women are not fit for universities, or that universities are not fit for women; such persons should abjure the neighborhood of institutions like the University of Michigan, and faithfully limit themselves to speculative data.—*Scribner's* for February."[30]

29. Proceedings of Societies, Dent. Cosmos, 16:425, 1874.

30. Women at Michigan University, Dent. Register, Vol. 31, February, 1876.

The first American woman to be graduated from the Pennsylvania College of Dental Surgery, and the second one from the United States to receive the degree of D. D. S., finished her two years' course of instruction in 1874. Two and a half years later appeared this article about her under the caption, "A Lady D. D. S.":

"It was recently our privilege to call upon and make the acquaintance of Miss A. Ramborger, D. D. S., of Philadelphia. She graduated one year ago in the Pennsylvania Dental College, occupying an enviable position in her class. We found her in her office, a very neat and convenient one, quite at home, without embarrassment, and appearing quite as natural in her novel position, as any one of the male persuasion. As to practice, she is making a splendid success, operating only for ladies and children—will not touch one of *us;* this seems pretty hard, but she knows best. As to her operations, everyone having knowledge of the same reported them as excellent.

"She of course had some prejudice to meet, and overcome, but she *can* and *is* doing it, and we do not hesitate to predict for her a noble and useful career; we only wish there were in our country, a thousand more like her; there is room; yes, more, a great demand. Three-fourths of all the operations upon the natural teeth of ladies and children, could be just as well done, and in a great many cases far better, by lady operators, than by men; let the latter haggle away upon one another, but women understand and appreciate the requirements of their own delicate and sensitive organizations and that of children as well, better than men can do. All success to Miss R."[31]

31. A Lady D.D.S., Dent. Reg., 30: 409, 1876.

This approving article on women in dental practice registers what seems to be the close of the period of agitation on the subject of woman's entrance into the profession, for the topic disappears from the pages of the dental journals until 1885, when an article by a British author called forth additional comment.

Beginning with the year 1865-1866, when Lucy B. Hobbs was elected to active membership in the Iowa State Dental Society and through its intercession and support was admitted to the Ohio College of Dental Surgery, and when Dr. James Truman delivered his momentous valedictory address, on down to 1873, when the decision was rendered in the Pennsylvania College case of the women students who had been refused the right to complete their dental training, the struggle to obtain for women the right to secure dental college education reached its climax.

In the words of the one who more consistently than any other man aided with lofty purpose and clear vision the pioneer women of dentistry, "It was in these seven years the struggle for professional education for women was fought out, and to a large degree conquered. The basis for this reform was laid during that period, and to the women engaged therein, the credit is justly due that their sex is today admitted almost universally to the dental colleges of this country."[12]

WOMEN GRADUATES OF DENTAL COLLEGES
(1866-1881)

Lucy B. Hobbs, Ohio College of Dental Surgery, Cincinnati, Feb. 21, 1866. (Dental Register, Vol. 20, p. 145.)

Mrs. Henriette Hirschfeld, Berlin, Pennsylvania College of Dental Surgery, Philadelphia, Feb. 27, 1869. (Dental Times, Vol. 6, pp. 172-175.)

Mme. Helene Vongl de Swiderska, New York College of Dentistry, New York, March 4, 1872. (Authority, the college records.)

Frau Marie Grubert, Berlin, Ohio College of Dental Surgery, Cincinnati, March 6, 1872. (Dental Cosmos, Vol. 14, p. 270.)

Emilie Foeking, Danzig, Prussia, Ohio College of Dental Surgery, Cincinnati, 1873. (Dental Cosmos, Vol. 20, p. 247.)

Louise Jacoby, Germany, Baltimore College of Dental Surgery, Feb. 26, 1874. (Dental Cosmos, Vol. 16, p. 190.)

Annie D. Ramborger, Pennsylvania and Valeska Wilcke, Prussia, Pennsylvania College of Dental Surgery, Philadelphia, Feb. 28, 1874. (Dental Cosmos, Vol. 16, p. 191.)

Pauline Boeck, Germany, Baltimore College of Dental Surgery, 1877. (Dental Register, Vol. 31, p. 183.)

Elvira Castner and Adolphine Petersen, Germany, Baltimore College of Dental Surgery, 1878. (Dental Cosmos.)

Annie Riley, Ohio, Ohio College of Dental Surgery, 1880. (Dental Cosmos.)

Clara Kunast, Germany, Pennsylvania College of Dental Surgery, Philadelphia, 1880. (Dental Cosmos.)

Alma W. E. Fuellgraff, Germany, and Evelyn Pierrepont, England, Michigan University Dental School, Ann Arbor, 1880. (Dental Cosmos.)

Jennie C. Kellock, Illinois, Michigan University Dental School, Ann Arbor, 1881. (Dental Cosmos.)

Jessie F. Detchon, Ohio, Philadelphia Dental College, 1881. (Dental Cosmos.)

Anna von Doemming and Olga von Oertzen, Germany, and Lizzie E. Pepper, Pennsylvania, Pennsylvania College of Dental Surgery, Philadelphia, 1881. (Dental Cosmos.)

VINCENT'S INFECTION*

By ARNOTT A. MOORE, Buffalo, N. Y.

ONE of the most important and difficult problems which the dental profession has before it today is that of the acute surface infections of the mouth. Much research has been done on the subject and much more is needed before the end will be in sight. All points of view and angles of the problem should be discussed and considered most thoroughly. I shall attempt to present the point of view of the oral surgeon.

Many cases of acute mouth infections are seen first by the physician, who, being in closer touch with the oral surgeon than with the periodontist or the general dentist, calls the former. Another factor in his calling the oral surgeon is that many of these patients are very sick and must be seen either at home or at the hospital. The physician has found that few dentists care to make calls or do work outside the office. Be that as it may, the oral surgeon is often called to see patients suffering from acute surface infections, and many times has to care for them until the infection has passed the acute stage.

His point of view, therefore, is different from that of the periodontist or the general dentist. In the first place, his training and general routine is different. He is used to handling serious infections and is liable to be more radical in an attempt to get speedier results. Incidently, he seldom sees the case subsequently to the subsiding of the acute symptoms. Hence, it must be remembered that this paper is written by one

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who is not able to handle the cases in the comparatively leisurely manner of the periodontist or general dentist.

We all know that Vincent's is a mixed infection, which, by the way, may account somewhat for the rapidity of its progress and the complexity of its symptoms. The invading bacteria are Vincent's spirochete and *Bacillus fusiformis,* two organisms which are practically harmless when separated, but far from harmless when growing together in the tissues. Vincent's is generally supposed to be a surface infection. I do not agree with this for several reasons, a few of which are (1) the presence of glandular symptoms; (2) the recurrence of disease after treatment and after smears are negative; (3) the death of pulps during treatment, and (4) response to general treatment.

The foregoing is clinical evidence and has not been worked out in the laboratory. The idea is advanced at this time to promote research and discussion on this phase of the subject.

The bacteria mentioned above attack the soft tissues of the mouth, throat and nasopharynx, and, later in the course of the disease, the submaxillary and sublingual glands and the cervical nodes, producing the condition known as Vincent's infection. The disease is characterized by considerable induration and sloughing and progresses very rapidly. The breath is fetid, and there is more or less pain in the teeth, gums and neck glands. The general symptoms are rather pronounced, the patient being toxic, with a marked general malaise and a septic temperature ranging from 99 to 105. The neck glands are always more or less involved in acute Vincent's infection and the treatment of the case should be regulated with that in mind.

The diagnosis of Vincent's infection is always made by means of the microscope, the smear showing large numbers of Vincent's spirochetes and *Bacillus fusiformis.* There are always stray bacteria present, but these are greatly outnumbered by the strains mentioned. Care should be taken not to confuse Vincent's spirochete with *Spirochaeta pallida,* and, if there is any doubt as to the identity of the organisms, they should be examined under the dark field.

The predisposing factors in Vincent's infection are principally improper diet, lack of adequate prophylactic care on the part of both the patient and the dentist, and gingival irritation. Vincent's locally is purely and simply a filth disease. If the patient does not, or is not able to, thoroughly clean every portion of the mouth, and if the dentist has not removed all tartar deposits, overhanging fillings, crowns, bridges, cavities, roots, and partially erupted teeth, Vincent's infection is liable to develop.

Vincent's disease seldom occurs in a clean mouth, which puts a great responsibility directly on us as dentists to leave all of our patients in such condition that they cannot contract the disease on account of poor dentistry. Furthermore, we can, and should, so train our patients that they will take care of their mouths in the intervals between visits to our offices. The latter statement is not at all impractical, even though every mouth is more or less a law unto itself. We can have the patient try different dentifrices, toothbrushes and methods of prophylaxis until they report to us with no plaques or food deposits, or any signs of irritation in their mouths. It is realized that this would require a large number of visits. On the other hand, they need not be lengthy ones and our patients would be so trained that their mouths would be well taken care of daily instead of once, twice or three times year. Remember,

then, that Vincent's is usually a filth disease and that an ounce of prevention is worth a pound of cure.

The treatment of Vincent's infection should be both local and general. The latter should be in charge of a competent physician and should include general therapeutic measures such as complete rest, correct diet and attention to the bowels. As a general rule, the diet should be soft and should contain a large amount of raw fruit but not uncooked starches. Complications of a general nature, which must be met by the physician as they arise, cannot be discussed here.

Gentleness should be the keynote of the local treatment, and therefore the tissues should not be disturbed any more than is absolutely necessary. In the cleaning of the mouth and teeth, cotton swabs, rather than a toothbrush, are used, which minimizes trauma incident to prophylaxis. As tissues may be injured chemically as well as mechanically, the choice of the antiseptic to be used is of great importance. Many antiseptics are injurious to body tissues. These must be avoided. The antiseptic of our choice must kill or interfere with the growth of bacteria and must not coagulate albumin or interfere with phagocytosis. Preferably, it should be water soluble and of such nature that it will not be decomposed in the presence of serum or the débris found in acute infections. After an antiseptic which meets these requirements has been chosen, it should be applied with the utmost gentleness to the affected parts while the infection is acute. Sloughs should not be disturbed, neither should the swollen or irritated tissues. The use of swabs or applicators is recommended at this time; whereas, later in the course of the disease, the antiseptic may be injected into pockets and under the free margin of the gums by means of syringes with blunt-pointed needles.

The antiseptics recommended for use in Vincent's infection are acriviolet, arsphenamin in glycerin and a weak solution of ammonium fluorid. Any of these are gently applied by means of swabs while the infection is acute. It is my custom to use acriviolet in a 1 per cent solution twice daily until the acute symptoms and sloughing have subsided; then to alternate occasionally with the arsphenamin in glycerin, or the ammonium fluorid solution, as bacteria are liable to become immune to an antiseptic if used continuously. The mouth wash used is of great importance, a 1:5,000 solution of mercuric chlorid in hydrogen peroxid being recommended. During the acute stages, the teeth should not be cleaned by the patient, as, every time a hemorrhage is produced, there is more pabulum for the bacterial growth. After the acute stage is passed, a 0.5 per cent solution of tannic acid in alcohol acts as a very efficient astringent and stimulant to the tissues involved. The general treatment is as outlined above with the exception that aluminum subacetate compresses (from 2 to 4 per cent) reduce glandular symptoms to a marked degree.

As soon as the acute symptoms begin to subside, a complete roentgen-ray examination should be made, and the treatment should be governed to a great extent by the findings. The teeth should be gently but thoroughly scaled, even though several appointments are required. Mild suction should be applied to the gums at the necks of the teeth and interproximal spaces and acriviolet freely used at the end of each sitting. All gingival irritants such as overhanging fillings, crowns, cavities and bridges should be removed. It is important that the case be treated daily at this stage of the

disease. It will be noted that there is a marked improvement in the clinical appearance soon after this daily treatment is instituted. When this change for the better takes place, it is perfectly safe to extract roots, partially erupted teeth and uncleanable and hopelessly infected teeth. This statement must not be misunderstood. It is never safe to extract teeth during the acute or semi-acute stages of the disease. Extraction of teeth in cases being treated by the above outlined method can be safely accomplished much sooner than was previously thought possible.

Sockets should be drained, but not packed, and the entire mouth should be taken care of as though the disease were still acute. The only exception to this statement is that the mouth wash should be changed, as an oxidizing agent should not be used in the presence of an organizing blood clot. It is recommended that the following mouth wash be substituted: for the hydrogen-peroxid bichlorid wash used during the acute stages;

Hydronaphthol ..... 1 gm.
Alcohol .....40 gm.
Aqua .....20 gm.
Methyl salicylate .....13 cc.
Sig: Teaspoonful in glass of water as mouth wash.

When sockets have healed, it is well to have the oxidizing mouth wash used at least once a day for four or five weeks. The patient should, at this time, be carefully trained to brush the teeth correctly and to use dental floss correctly. A careful check-up should be made from time to time as to the efficiency of the patient in thoroughly cleaning the mouth. Plaques should be removed and their reformation prevented. Spots where food particles are retained should be called to the attention of the patient and he should watch them from day to day to see that they are cleaned. In the meantime, the antiseptic being used should be freely applied oftener than would seem necessary and smears should be taken. At this time, it is well to scale the teeth again. This treatment should be continued until negative smears are obtained two weeks apart, and until the dentist is convinced that the patient can and will keep the mouth clean. If this is done, there should be no recurrence of the disease.

SUMMARY

The treatment of acute Vincent's infection is simply a process of killing the bacteria by use of certain drugs, thorough prophylaxis of the mouth and removal of all gingival irritants.

The procedure in cases of chronic Vincent's is practically the same as that given above. The soft tissues are swabbed for two or three days with acriviolet before they are disturbed by scaling or other work. The treatment in these cases should be prolonged until all curable pockets are healed and negative smears are obtained.

Here, it is rather interesting to note changes which take place in smears from the acute to the chronic stages. In the acute stage of Vincent's infection, we usually find large fusiform bacilli and spirochetes with practically nothing else in the field. In chronic Vincent's, we find the fusiform bacilli and spirochetes smaller, with an intermingling of streptococci. Later, we find streptococci predominating and a few staphylococci, fusiform bacilli and spirochetes in the field. Noting these changes in the character of the infection, it occurs to me that Vincent's infection may be one of the predisposing factors in the development of certain types of so-called pyorrhea. The change from a fusiform bacillus-spirochete infection to a streptococcus-

staphylococcus-fusiform bacillus-spirochete infection may be a part of the course of pyorrhea.

CONCLUSION

Vincent's is an infection of the utmost seriousness, as shown by the marked local and general reaction which it produces. Examination of the patient should be thorough with particular reference to the mouth, throat, neck and intestinal tract. It is more or less a filth disease and should be treated as such by the dentist and the patient. Antiseptics should be used which do not injure tissue or interfere with phagocytosis. All sources of gingival irritation should be removed at any cost if recurrences are to be prevented. The subject is deserving of more research than it is receiving, and there should be more discussion from different points of view. It is for this reason that I am giving mine, although I am not a periodontist.

40 North Street.

DISCUSSION

F. J. Reichmann, Oklahoma City, Okla.: Dr. Moore says that the fusiform bacillus and the spirochete, when separated, are harmless. I should like to know who has been able to separate them. As far as I know, that has never been accomplished. I have succeeded in growing the fusiform bacillus and the spirochete, and have tried for the last two or three years to separate them, and have come to the conclusion that they are two forms of one and the same organism. If anyone will tell me how to separate them, I shall appreciate it very much. Dr. Moore asks us to be careful not to confuse the spirochete of Vincent's with the spirochete of syphilis. The spirochete of syphilis is extremely difficult to stain. I doubt if there are more than one or two men in this room who know a technic for staining the spirochete of syphilis, and yet we see that repeatedly in these papers on Vincent's infection. There is absolutely no danger in stained slides of confusing the spirochete of Vincent's with that of syphilis. In the dark fields, we can see both of them, but the spirochete of syphilis is so very different in its characteristics that there is no danger of confusing them. In the first place, the fusiform bacillus is highly motile, and Vincent's spirochete is highly motile. They move. The spirochete of syphilis is always motile, too, but while it makes much commotion, it doesn't travel or get anywhere on the field; that is, to any appreciable extent. Dr. Moore says this is a filth disease. In approximately 400 or 500 cases in private practice, I have found a very small percentage in filthy mouths. Of course, it depends upon the practice. In the clinics, you will find more cases in filthy mouths. If the cases are taken from private practice, you will find that it is not necessarily a filth disease.

E. Krieger, Baltimore, Md.: There is a question I should like to ask. I had the opportunity in the hospital of seeing a number of cases of Vincent's infection that were combined with pemphigus, a very serious skin disease, and it was a question whether this was originally a case of pemphigus or of stomatitis. Every one of these cases had Vincent's infection in combination with the pemphigus. Was it originally pemphigus or Vincent's stomatitis? With reference to Vincent's being a constitutional disease, this is true. We had a number of cases of Vincent's, and every one showed a very peculiar blood picture. Recently, we had one case, and we almost came to the conclusion that the blood picture was similar to that of leukemia. Dr. Miner, of Boston, was called in to determine whether it was leukemia, and he said that it was Vincent's beyond question. The injection of arsphenamin has aggravated the condition. The patients became very ill. As soon as the arsphenamin was stopped and sodium perborate used exclusively, the patients improved. This particular case was in a very clean mouth. The condition doesn't necessarily develop in only filthy mouths.

H. W. Burnett, Fairmont, W. Va.: Sodium perborate is the paramount therapeutic agent in this condition. Dr. Bloodgood, of Johns Hopkins University told me of this treatment. He described the clinical picture of Vincent's infection as found in the mouth, and his technic of applying treatment. Sodium perborate, a white powder, is applied in the mouth with a cotton sponge, wrapped around an applicator, dipped into the powder and rubbed into the tissues dry. This is followed

by common baking soda solution, sodium bicarbonate, which the patient is instructed to use two or three times a day. You will be agreeably surprised how rapidly the condition yields to this treatment. Many of the other treatments suggested have been tried by myself and others with negligible results; in some cases, very marked results. The physician must cooperate in the treatment with the idea that it is a systemic condition and not purely local. The fetid breath and glandular involvement mark it as a systemic condition of local origin. I know of four or five deaths, in the past four or five years, that have resulted from this infection, which often occurs in combination with other diseases.

A. B. Vastine, Danville, Pa.: Mouth hygiene has little or nothing to do with Vincent's disease. There are certain pathologic conditions beside syphilis, diphtheria and incipient epithelioma that may be mistaken for this disease. One is acute lymphatic leukemia. I have been called to see a few of these cases that were supposed to be acute Vincent's disease, but actually were reactions associated with a late stage of acute lymphatic leukemia. This is a very important differential diagnosis. The reason that Vincent's disease is so frequently mistaken for a constitutional ailment is that these organisms open the way for a secondary infection. We have associated with this form of spirochetosis other organisms which have a marked focal potential. The spirilla are so often an important entity in focal infection because these organisms, together with the ameba, may merely form a portal of entrance for other bacteria which produce focal manifestations such as myositis and neuritis. I regret that amebic infection has not been mentioned in this paper because it is so frequently an associated entity which may keep the local reaction up long after the Vincent's is largely cleared up. It may also help in forming a portal of entrance for other organisms, thus helping to establish the vicious cycle of focal infection. As regards the dentist's referring a patient suffering from Vincent's disease to the physician to have the so-called constitutional factors cared for: if the dental man, having no appreciation of the fact that Vincent's disease is a local entity with a marked focal potential, sends the patient to a general medical man to be treated for a constitutional disease, it becomes too often a case of the blind leading the blind. I fully believe that the one assuming the responsibility should be capable of handling these cases from all angles if he approaches them at all. The question is not whether he is a physician or a dentist, but whether he has a grasp of the whole matter. Too many of these conditions are merely reduced from the acute to a chronic type of infection. When we have spirochetosis of the gingiva, we may also have spirochetosis of the associated parts, which is not always easy to demonstrate. The nasopharyngeal complications in this disease are far beyond the present recognition of either the medical or dental professions. Spirochetosis of the lungs is not at all uncommon; spirochetosis of the liver is possible. Therefore, we can see how easy it is to mistake the constitutional factor. That which is often referred to as a constitutional cause is not a cause but a direct result of the Vincent's disease.

Boyd S. Gardner, Rochester, Minn.: I should like to have Dr. Vastine tell us how he treats these cases.

Dr. Vastine: My technic for this treatment we call subgingival therapy. The treatment is based upon the fact that an understanding of this subject must necessarily rest upon a knowledge of the causative factors in the malady to be treated. I shall confine my remarks to the care of the positive causes for the disease. The positive causes are largely organisms. The recognition of the distinct classes of organisms entering into gingival infections is the foundation upon which subgingival treatment rests, more especially those organisms found in the anatomic trench about the cervices of the teeth. The most commonly found pathogenic organisms are Vincent's spirilla, the ameba and the cocci. Other bacteria also have to be reckoned with, but are not so prevalent. Subgingival therapy rests upon the use of a specific or near-specific introduced to the point of incubation without an appreciable dilution of the medicament used. The medicine is introduced by the use of a suitable rubber cup attached to a contra-angle porte polisher or a hemostat. The cup is filled with the agent, contact is established with the tooth, and the edge of the rubber is introduced under the free margin of the gum by a pumping motion, this causing adhesion which enables the drug to be carried into the deepest pocket and expelled. This method enables the operator to convey the specific or

near-specific under the gingiva to the point where actual destruction of the osseous or other structure is going on. For the Vincent's organism we are at present using arsphenamin, 5 per cent, in glycerin, and in severe cases the pure arsphenamin powder. The powder is used by touching the moist rubber cup to the preparation. Sufficient will adhere to the margin to permit effective medication to be made at the point of active spirochetosis. The majority of the streptococcic infections are controlled by introducing subgingivally a 5 per cent aqueous solution of mercurochrome. This has not proved effective for all streptococcic infections. Application is made immediately prior to that of the arsphenamin. For the staphylococcus, we have found acriviolet, 1 and 2 per cent solution, effective. For the ameba, we use one-half grain of emetin hydrochlorid, in 1 c.c. aqueous solution, hypodermically, employing the intramuscular injection in the arm. In some cases in which there is a local reaction from the intramuscular use of emetin, it is given intravenously. These treatments are used daily or weekly as smear findings may indicate. Topical applications are not only made subgingivally to every tooth in the mouth, but, in acute spirochetosis, nasopharyngeal treatment is instituted, chiefly with the 5 per cent arsphenamin in glycerin. At times, other organisms are present which require suitable treatment; for instance, in those infections recognized as regurgitations from the intestinal tract. One must always keep in mind that the unusual infection may be associated with oral lesions. It is important not to confuse the clinical improvement that takes place with the improvement which can be registered only by microscopic examination or the smear findings. The possibilities of subgingival therapy are very great. It is the most effective method that we have yet found for preoperative preparation, a most effective method for the treating of acute and chronic gingivitis; for infections around erupting third molars; for controlling certain cases of osteomyelitis; for relieving acute periapical infection; for treating in children glandular involvements having origin in gingival or follicular infections; for the treatment of, or preparing for operating in, maxillary sinusitis of dental origin, whether of a periapical or gingival source. And so on through the whole realm of most oral diseases, we have a direct or indirect use for subgingival therapy.

Joseph P. Wahl,† New Orleans, La. (closing): Many fine points have been brought out here this morning, and if Dr. Moore were present he might be able to enlighten us. Dr. Moore brought out several points that are very interesting. One is that Vincent's infection is not a surface infection. Several years ago, in the early treatments of Vincent's, on various occasions, after I had dismissed my patient as cured, possibly forty-eight or seventy-two hours, I would get a telephone call telling me that he had a severe hemorrhage about the necks of some of the teeth. At that time, we used a compress with some hemostatic serum, and tried to stop these conditions. We found the compresses of no avail. Then by searching around and finding the pocket of the deep-seated places and applying our old remedy of 7 per cent chromic acid, we immediately stopped the hemorrhage and there was no recurrence. That substantiated the fact that these lesions are much deeper than most of us think.

†Dr. Wahl read Dr. Moore's paper in the latter's absence.

FUSOSPIROCHETAL INFECTIONS OF THE MOUTH*

By ISADORE PILOT, M.D., Chicago, Ill.

INFECTIONS by the fusiform bacillus and its symbiotic spirochetes have been recognized, clinically, largely as specific entities about the teeth such as ulcerative gingivitis (Gilmer's disease), and in the throat as Vincent's infection. Not enough emphasis has been placed on lesions of a somewhat different character in which these organisms may be found in abundance. The exact etiologic relationship is often questioned as these bacteria are part of the normal flora of the mouth. It is our purpose to discuss the rôle these anaerobes may play in a variety of infections and to illustrate their importance, not simply as secondary invaders but also as the causative agent in the production of certain putrid and necrotic lesions. The association of the fusospirochetes with other more virulent organisms may modify the character of the primary infection.

To bring out clearly this relationship, it would be well to review briefly our observations on the normal distribution of these anaerobes in the oral cavity. About the teeth, these organisms have been known to flourish particularly in the tartar. Davis[1] emphasized their frequent occurrence in granular oval masses in the crypts of the tonsils. He brought out the striking resemblance in the grouping of these bacteria in both regions in the formation of brushlike processes made up largely of leptothrix or mycelial threads, about which, in a radial arrangement, are seen numerous bacilli and spirochetes interspersed with cocci.[2] In the tonsils, we have demonstrated the bacilli in 82 per cent, spirochetes in 25 per cent.[3]

Under certain conditions, these organisms vary considerably in numbers. In the new-born as well as in the toothless aged, the spirochetes are absent, although the fusiform bacilli can be demonstrated in small numbers. In persons neglecting the daily cleaning of the teeth, large masses of bacteria accumulate in the abundant tartar. In smears made from the mouths of medical students, spirochetes were demonstrated in only 50 per cent; whereas, ward patients in a hospital, on entrance, almost all showed abundant spirochetes. It would appear that the habit of habitually washing the teeth, using various dentrifices, reduces enormously the incidence of various bacteria of the mouth, particularly the spirochetes. We have noted that the

*Read before the Section on Oral Surgery at the Midwinter Clinic of the Chicago Dental Society, Jan. 25, 1928.

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1. Davis, D. J.: Actinomyces-Like Granules in Tonsils, J. Infect. Dis., 14:1-7 (Jan.) 1914.

2. Davis, D. J., and Pilot, Isadore: Studies of B. Fusiformis and Vincent's Spirochetes: Habitat and Distribution in Relation to Putrid and Gangrenous Processes, J.A.M.A., 79:944-95 (Sept. 16), 1922.

3. Pilot, Isadore, and Brams, J.: Studies of Fusiform Bacilli and Spirochetes. IV. Occurrence in Tonsils and Adenoids, J. Infect. Dis., 33:134-138 (Aug.) 1923.

same ward patients will show fewer organisms after a few days of enforced hygiene of the mouth.

The specific throat infection of Vincent's would appear to be the result of exogenous strains in many instances. The same may be said for acute ulcerative gingivitis. Both conditions have been known to occur in mild epidemic form in institutions and in groups of soldiers. Many observers have noted transmission of the infection to susceptible members of the same family. It is needless to go into the details of the clinical appearances and course which have been so well described, but it should be pointed out that the smears made of the lesions reveal large numbers of bacilli and spirochetes, often in pure culture or associated with a few diplococci. The facts seem to indicate that virulent strains, perhaps introduced by carriers, are responsible for these lesions.

With reference to the question of virulence, an interesting lesion may develop from a bite. We have reported one instance of gangrene of the finger in which many fusospirochetes were demonstrated after a bite received during a fight.[4] It has been noted that certain tribes of Africa and Hawaii are known for their dangerous bites. It is quite possible that these persons harbor more virulent strains than are usually found.

Ulcerative gingivitis commonly becomes chronic and Vincent's angina occasionally becomes stubborn. Chronic lesions independent of these entities may be due to anaerobes as a rule associated with other pyogenic bacteria. Davis and Moorehead[5] describe their occurrence in the pus of alveolar abscesses about the teeth. In the tonsil, we[6] have observed four instances of a chronic infection characterized by foul breath and an abscess usually communicating with a crypt. In the abscesses of both teeth and tonsils, the striking characteristic is the putrid character of the purulent material. Many cases of pyorrhea have a similar odor and in smears reveal the same bacteria. The appearance of the smears from these lesions differ from those of Vincent's infection. The bacilli and spirochetes, while they may be numerous, are not present alone but are intermingled with many cocci and other bacteria. The cocci, on culture, prove most often to be streptococci and more often the viridans than the hemolytic type. The lesions therefore cannot be considered a pure fusospirochetal infection, but are mixed or complicated by pyogenic bacteria. That necrosis and the putrid character are due to the anerobes is evident because odorless abscesses seldom contain these bacteria. The association with streptococci is noteworthy because these cocci are also the most constant associated bacteria in putrid lung infections. The viridans type, like the fusiform bacilli, may be anaerobic in the first cultures. The sources of the chronic infections appear to relate back to the bacteria already present in the mouth.

The bacilli and spirochetes normally residing in the oral cavity have been referred to by Davis as opportunists rather than saphrophytes. By lowering the resistance of the local tissues, the existing

4. Pilot, Isadore, and Meyer, K. A.: Studies of Fusiform Bacilli and Spirochetes. XII. Occurrence in Gangrenous Lesions of the Fingers, Arch. Dermatol. & Syphilol., 12:837-839 (Dec.) 1925.

5. Davis, D. G., and Moorehead, F. B.: Studies of Fusiform Bacilli and Spirochetes. VIII. Their Occurrence in Alveolar Abscesses, J. Dent. Res., vol. 5, 1923.

6. Pilot, Isadore: Fusospirochetal Abscess of the Tonsil, Arch. Otolaryngol., 5:244-248 (March) 1927.

organisms gain a foothold, proliferate, modify considerably the underlying lesions or produce a necrotic type of inflammation. They find an excellent soil in tooth cavities, in the wounds of extracted teeth or in those following tonsillectomy, producing a putrid, suppurative or sloughing inflammation, which may extend to the soft tissues of the neck, causing an extensive cellulitis. In acute throat infections, we have observed the anaerobes occasionally, in few or abundant numbers, in the pseudomembrane of diphtheria and in the loose membrane of streptococcic sore throat. In syphilitic lesions, as in mucous patches of the tonsils, cheeks and lips, they may be associated with *Spirochaeta pallida.* In one instance, considerable numbers of bacilli and spirochetes of the Vincent's type were demonstrated from a gumma of the tongue. An interesting growth of these organisms in masses not unlike actinomyces in their formation was observed in the lesion of pharyngomycosis. Between the layers of the thickened epithelium, masses of bacteria can be seen as infiltrating growths (Davis and Hall.[7]) In leukoplakia of the tongue, these masses were not demonstrated, but instead, large numbers of yeast cells. The anaerobes have a great tendency to grow in profuse numbers in the ulcerating lesions of malignant growths and are responsible for the marked necrosis and the putrid odor that may be present in such growths about the oral cavity. Recently, we observed an ulcerating lesion of the tongue from which, in smears, bacilli and spirochetes in large numbers were demonstrable. As the lesion was only present for four weeks, a clinical diagnosis of Vincent's infection was first made. Our own impression was that the infection was of secondary importance. Biopsy revealed a typical squamous-cell carcinoma, with marked surface ulceration and necrosis. This case is mentioned in order to bring out the fallacy of making a diagnosis from bacteriologic smears. In three cases of carcinoma of the tonsils, a similar bacteriologic picture was observed. In one instance, a metastatic sarcoma nodule appeared on a buccal surface. The lesion was foul and markedly ulcerated, and in smears as well as in the Levaditi preparations of the excised tissue, enormous numbers of bacilli and spirochetes were found.

Lowered resistance through general conditions may precipitate a fusospirochetal infection of the mouth. Most remarkable is the associated stomatitis in patients with acute lymphatic leukemia. In one instance, a large gangrenous area (noma) developed on the cheek. The relationship between these infections and the leukemic state has not been adequately explained, but the association is more than coincident, and undoubtedly one is etiologically related to the other. Two other instances of noma should be mentioned from our experience in which the first manifestations of the illness were the mouth symptoms. In one, at necropsy, a severe toxic anemia was present in a patient receiving neo-arsphenamin; in the other, the gangrene was superimposed on a greenish tumor mass at the base of tongue of a patient who, at necropsy, has similar tumor masses in other parts of the body, the condition of chloroma. In chronic leukemia, mouth infections were less frequently observed, and in pernicious anemia, we have noted no decided changes in the flora.

Most noteworthy are the marked changes in the gums in patients with

7. Davis, D. J., and Hall, A. K.: Fusiform Bacilli and Spirochetes in Relation to Pharyngomycosis, J. Infect. Dis., 34:203-208 (Feb.) 1924.

scurvy. The stomatitis was often the first symptom, and in several patients, the patients went first to the dentist on account of the foulness of the mouth and the loose teeth. The gums were swollen, and foul pus oozed from the margins. In the smears, the bacilli, spirochetes and cocci were found in abundance. In one patient with a fever of 101 F., on special mediums a few colonies of *Streptococcus viridans* appeared in the blood culture, illustrating that bacteremia may result from deeply infected gums. The antiscorbutic diet led rapidly to marked improvement of the state of the gums and reduction in the number of anaerobes. The association of marked pyorrhea with scurvy clearly demonstrated the relationship between avitaminosis and mouth infections, and it is quite possible that deficiencies in diet may be the source of obscure mouth infections or a factor in the prevention of healing. In pellagra we have found no decided change in the flora in connection with the anaerobes.

To ascertain whether diabetic patients were susceptible, smears were made. These showed no remarkable deviations from the normal. However, the patients were all well controlled, under medical care. Neglected or untreated patients may reveal a predisposition for mouth infection.

The outstanding symptom in fusospirochetal infection of the mouth is the foul breath. It is, of course, recognized that foul breath may arise from other causes, for example, bronchiectasis, lung abscess or gastro-intestinal disturbances; but, in a large number, the odor is due to the accumulation of these bacteria in the tartar or in the firm cheesy-like masses of the tonsil. When an actual lesion develops, as in stomatitis, Vincent's angina, noma or ulcerating carcinoma, the odor is often intensely putrid. The patient may come to the dentist or the physician with this complaint. In such persons, it is necessary to look for local lesions and then investigate possible underlying general factors, through history of diet, examination of the blood and physical examination.

Patients who have developed fusospirochetal abscess or gangrene of the lung may frequently show a deplorable state of the mouth, with numerous anaerobes about the teeth and marked pyorrhea. Although this association is not constant, it is suggestive that the source of the pulmonary lesion may be the bacteria of the mouth. This is particularly emphasized by the high percentage of abscesses of the lung that are due to or follow operative procedures under general anesthesia, especially tonsillectomy, and occasionally extraction of teeth under gas. The abolition of the cough reflex leads to aspiration of mouth secretions into the bronchi, with subsequent bronchopneumonia and abscess formation. In one patient, a tooth was demonstrated in an old bronchiectatic cavity thirty-five years after removal under gas. He developed a gangrene about this cavity because of lowered resistance from diabetes. In a child who succumbed to fusospirochetal gangrene of the lung, a tooth was found in a bronchus. A tonsillectomy under ether anesthesia had been performed four weeks previously. The development of such lesions in the lung depends on the virulence of the organisms, the amount aspirated and the resistance of the individual.

The virulence of the mouth organisms, as well as the numbers present, to a great extent is due to the existence of a lesion. It has been noted that gangrene of the lung may result from extension from Vincent's infection. Any condition promoting large numbers of bacteria or

excessive deposits of tartar, granular masses of the tonsils or a lesion like pyorrhea, which enhances the virulence of the anaerobes, may be the basis for the development of fusospirochetal abscess or gangrene of the lung after anesthesia.

Prophylaxis to prevent fusospirochetal infection is not difficult and it is important in all patients. Those with tuberculosis, bronchiectasis, chronic bronchitis and other pulmonary lesions are susceptible to pulmonary abscess and should have constant care of the teeth to diminish the danger of such a complication. Of particular importance is the necessity of a clean mouth in a patient about to take an anesthetic, a step in the preparation frequently omitted by the surgeon. It is reasonable to expect that such patients have carious and loose teeth removed, tartar deposits reduced, granular masses expressed from tonsillar crypts and the mouth well cleaned before an anesthetic is administered. This routine would diminish not only fusospirochetal pulmonary abscess and gangrene but also pulmonary infection due to other organisms.

DISCUSSION

Thomas L. Gilmer, Chicago, Ill.: It was forty-three years ago that I first saw a case of the disease which I named acute ulcerous gingivitis. I saw very few patients suffering from it until the return of our soldiers from Europe after the close of the World War, when it was widely disseminated in this country. That it is a contagious disease, I am positive, since I have been definitely able to trace it from one person to another. In the *Dental Review* in 1906, I fully described the disease and gave my method of treatment. Prior to that time, no one had written about it. I tried to discover the cause of the disease and gave specimens taken from about the affected parts to several bacteriologic laboratories for cultivation, but none were able to find any specific organism to which the disease might be attributed. Later, I gave a specimen to Dr. Ruth Tunnicliff, who grew it anærobically and found that the predominating organism was the fusiform bacillus and spirillum. Since the mouth seems to be a natural habitat of this organism, one wonders why the disease is not more prevalent. Is it because of a temporary lowered resistance of the host that the organism is able to cause the disease, or is it because the germ becomes more virulent at times? Dr. D. J. Davis, Dr. Moody and I made a study of the bacteria of jaw infections generally and found that the usual acute infections of the jaws were due to the hemolytic streptococci, while those brawny, boardlike swellings about the angle of the jaw from the erupting lower third molars were due to the streptococci and *Bacillus fusiformis* in symbiotic relation.

F. C. Husband, Toronto, Canada: I was much impressed by Dr. Pilot's remarks on Vincent's infection, especially his linking up intestinal conditions with this disease. Dr. Gilmer's observation was also interesting; viz., that it was rare before the war but that, during the war, it showed a tremendous increase, being spoken of as trench mouth. Following the return of the men from overseas, I undertook to question many of them, laymen, as to their observations of their fellows who fell victims to the disease, and the one unaltering reply was this, that when the men came out of the trenches exhausted, many of them fell to gorging themselves with food and it was these men who developed the disease. It would seem that the excessive indulgence in food, excited by their exhaustion and long privation, together with the condition of their digestive organs, greatly lowered in vitality, induced a serious condition of autointoxication and prepared the host for these manifestations. Dr. Harold Keith Box has shown in his work that toxemia is the fundamental cause of pericementitis. The same thing has been stressed by Dr. Pilot.

Dr. Pilot (closing): I did not speak on therapy as I felt that most of you would be in a better position to give your experience. I wished to stress more the associated underlying causes. In pulmonary infection, we have noted improvement following the administration of the arsenicals. In stubborn cases of Vincent's infection, neo-arsphenamin, given intravenously, may afford quick results. Dr. Potts spoke of the development of the fusospirochetal infection in a syphitic

patient receiving arsphenamin, an occurrence also in one of our patients. This should not discredit arsenicals; for it should be pointed out that micro-organisms, like vertebrates, can acquire a tolerance for chemical agents which at first could readily destroy them. We have seen such cases as were mentioned by Dr. Gilmer, when an extensive brawny cellulitis of the neck arose from an infected tooth or followed an extraction after which the wounds closed quickly, giving the enclosed bacteria favorable anaerobic conditions. A similar brawny cellulitis may follow a tonsillectomy. In one patient, a large foul sloughing mass was removed from the site of the operation. The personal observation of the physician who stated that the incubation period appeared to be twenty-one days in acute gingivitis is very important as the time interval between transmitted cases has not been accurately noted. The question about the susceptibility of certain patients to infections is one that is difficult to answer; as in infection with other organisms such as the pneumococcus or the typhoid bacillus, it is impossible to predict which persons will be affected. It should be pointed out that further study on the influence of diet may throw more light upon the causes of mouth infection.

RESORPTION AND REPAIR ON THE SURFACE OF THE ROOT*

By BALINT ORBAN, M.D., Chicago, Ill.

BEFORE I show you the microscopic specimens, with the changes which take place during resorption and repair on the surface of the root, I must make clear to you the relationship between alveolar bone and cementum. We have to differentiate in the jaw between two parts, the alveolar bone and supporting bone.

In Figure 1, we see the difference between the two. Alveolar bone is only the bone lamella surrounding the root. This bone lamella, the lamina dura, may be seen in roentgenograms as a light line around the root. The other bone trabeculae running at right angles, or in other cases at different angles, to the alveolar bone, are the so-called supporting bone. These two parts of the jaw bone develop differently, development depending on different architectural laws. The development of the alveolar bone is due to the functional stimulus arising from the developing root. This functional stimulus can take place only after cementum is laid down on the surface of the root; which just precedes tooth eruption. By this, we see that the development of the alveolar bone depends on the deposition of cementum on the surface of the root. The explanation for this fact is simple: The dentin is built by the pulp and is laid down in the surrounding tissue, so there is no organic connection between dentin and the outer surrounding tissue.

The connective tissue of the pericemental membrane lies in contact only with the outer surface of the root, but is not attached to it. The periodontal membrane fibers become attached to the

*Read before the Illinois State Dental Society, Rock Island, May 11, 1928.

*From the Research Department of the Chicago College of Dental Surgery, Dental Department of Loyola University.

surface of the root by the deposition of cementum. The fibers of the periodontal membrane become embedded in the cementum and so attached to the root. While the root is growing and the tooth erupting, the fibers attached to the root become stretched and transmit the force

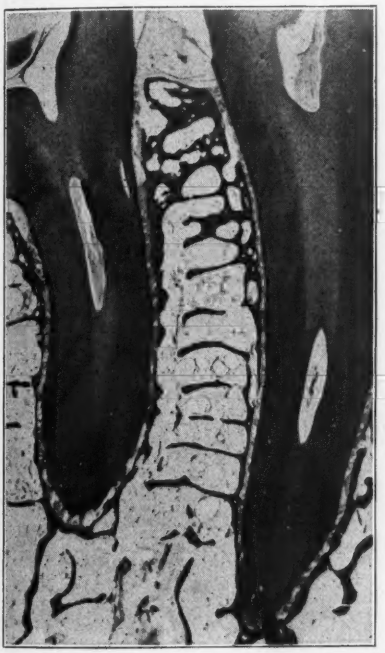

Fig. 1.—The bone lamella around the roots is the "alveolar bone"—the lamina dura. The bone trabeculae crossing the field belong to the supporting bone.

of the growth to the surrounding tissue. This transmission of the force of movement gives the functional stimulus to the development of the alveolar bone.

Figure 2 is a specimen showing a tooth germ at the point of eruption. One cusp has broken through the mucous membrane of the mouth. At *a*, we observe new bone trabeculae developing which are oriented in the direction of stress. A higher magnification, Figure 3, shows deposition of cementum on the surface of the dentin, and here we observe the new bone trabeculae oriented in the direction of the function.

Fig. 2.—Tooth with the tip of one cusp erupted. At *a*, note the development of the alveolar bone.

To summarize, the development of the alveolar bone depends on the deposition of the cementum on the surface of the root. Not only development, but also the presence of the alveolar bone, depends on the presence of the cementum.

If for any cause (inflammation, trauma, senescence) the cementum be-

comes resorbed, the adjacent alveolar bone is resorbed, owing to the lack of functional stimulus. If the cementum is resorbed, the fibers of the periodontal membrane lose their attachment to the

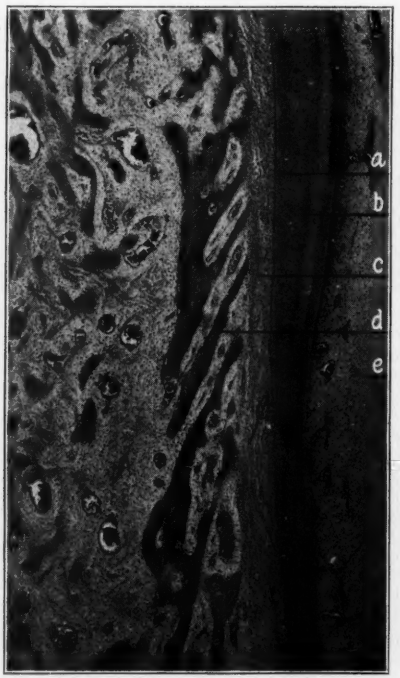

Fig. 3.—Area *a* from Figure 2 in higher magnification. *a*, cementum; *b*, dentin; *c*, periodontal membrane; *d*, developing alveolar bone (bone trabeculae are oriented in the direction of the eruption); *e*, pulp.

tooth. The stimulus of the function cannot be transmitted to the surrounding tissue, and so the alveolar bone becomes resorbed.[1]

Figure 4 is a specimen which shows the normal arrangement of the fibers of the periodontal membrane. The so-called principal fibers are attached on one side to the cementum, on the other to the bone, and are stretched obliquely between the two. We can follow the fibers into the bone where they are embedded.

Fig. 4.—Normal periodontal membrane. *a*, dentin; *b*, cementum; *c*, periodontal membrane, in which the principal fibers run obliquely from the bone to the cementum; *d*, alveolar bone with embedded fibers of the periodontal membrane.

1. Every resorption of the alveolar bone is not due to a loss of cementum. Trauma, inflammation, etc., can destroy the bone itself.

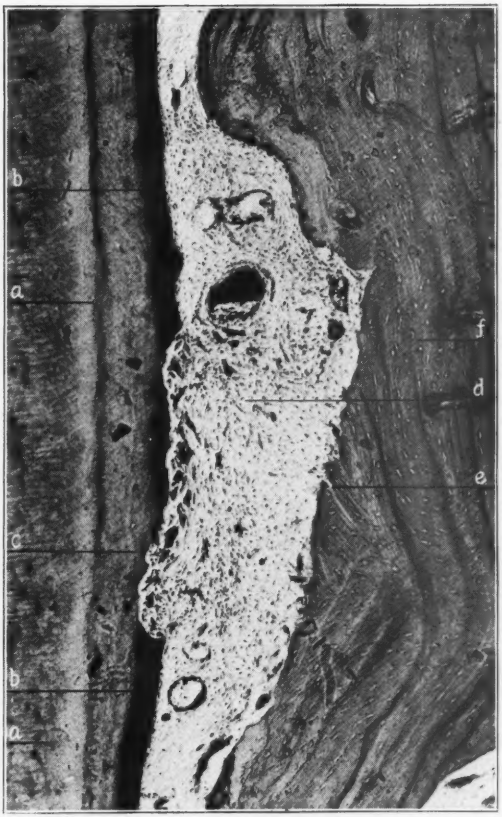

Fig. 5.—Resorption of the cementum and bone. *a*, dentin; *b*, cementum; *c*, resorption of cementum; *d*, periodontal space, in which the principal fibers are missing, only loose soft connective tissue being present; *e*, resorption of the bone; *f*, alveolar bone.

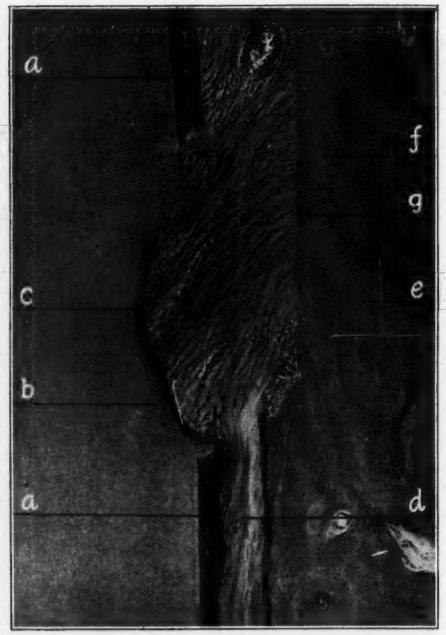

Fig. 6.—Beginning repair of area of resorption. *a*, cementum; *b*, line of resorption in the dentin; *c*, new cementum deposited in the resorbed area; *d*, normal width of the periodontal membrane; *e*, bone; *f*, line of resorption in the bone; *g*, new deposition of bone (the fibers of the periodontal membrane are stretched). (From I. Kohler.)

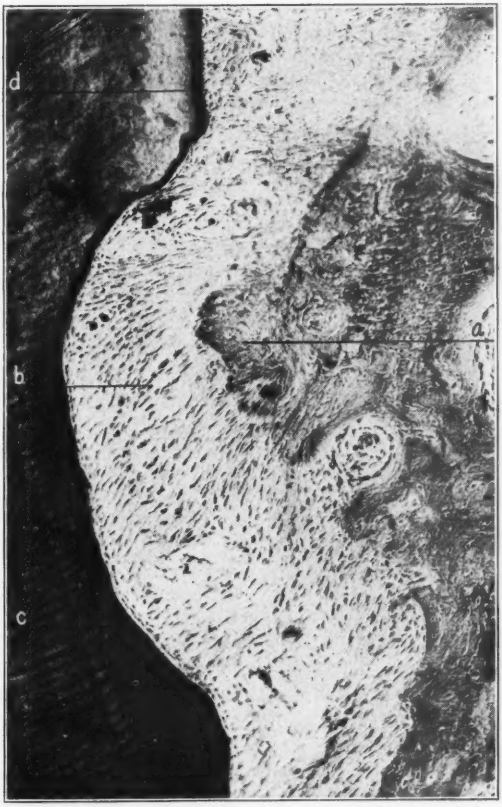

Fig. 7.—Functional repair. The bone *a* has grown toward the area of resorption and this growth has reestablished the normal width of the periodontal membrane *b*. *c*, new cementum on the surface of the resorption lacuna; *d*, unresorbed cementum.

Figure 5 shows the changes in the periodontal membrane when resorption takes place. The cementum is resorbed, and osteoblasts occupy the resorption lacunae. The principal fibers of the periodontal membrane have disappeared and soft connective tissue has taken their place. The fibers are not stretched, but run in every direction. The alveolar

Fig. 8.—Functional repair; deep resorption on the surface of the tooth; repair after resorption by reestablishment of the normal width of the periodontal membrane *d*. *a*, dentin; *b*, cementum; *c*, bone; *d*, periodontal membrane; *e*, new bone. (From I. Kohler.)

bone lying opposite the resorbed cementum is also resorbed. At the upper and lower end of the specimen, we observe the normal wide periodontal membrane with stretched fibers. This is the picture generally seen when resorption in the wall of the periodontal membrane has taken place.

The damage done by the resorption is not irreparable. Beginning repair is shown in Figure 6. In the lower portion of the picture is seen the normal periodontal membrane. Higher up, we see that the periodontal space is nearly three times as wide as is normal. This widening of the periodontal space is due to resorption on the surface of the root, as well as to resorption of the bone. The space between tooth and bone is not filled with soft loose connective tissue, but by stretched principal fibers. If we observe the specimen closely, we see deposition of new cementum on the floor of the resorption lacunae, deposited in the floor of the resorbed area after the cause of the resorption has subsided. By the deposition of new cementum, fibers again become attached to the surface of the root and the functional stimulus is again transmitted to the surrounding tissue. As a result, new bone is built as we see it in this picture.

Figure 7 shows that the repair after resorption in the functional meaning is completed when the normal width of the periodontal membrane is reestablished. In this specimen, there is resorption deep into the dentin. The floor of the resorbed area is covered with cementum. By this new cementum, fibers become attached to the tooth, and we see here the principal fibers of the periodontal membrane. New bone formation has reestablished the normal width of the periodontal membrane.

The most surprising case of possible repair is shown in Figure 8. The resorption on the surface of the root has undermined the cementum. A thin layer of cementum covers the floor of the resorption area. The surrounding bone has grown into the resorbed area and filled the space, leaving only the normal thickness of the periodontal membrane. By

this process of repair, the functional connection between bone and tooth is reestablished, functional repair resulting.

I will show you a few other cases of resorption and repair on the surface of the roots. Figure 9 shows molar teeth of a monkey. The sections are somewhat oblique so the pulp chambers of the teeth are not sectioned. We observe several absorbed areas on the apices and sides of the roots. Special attention is called to the root of one of the molars, *a*. roots approached each other. Similar cases have been reported recently by E. Kellner. In this case, the cause of resorption has subsided, and repair is allowed to take place. Cementum is deposited in the resorbed areas and the dentin everywhere is covered by cementum.

Figure 11, a human specimen, shows the second and third molars. The second molar shows a large carious area in the crown portion. The contact point is

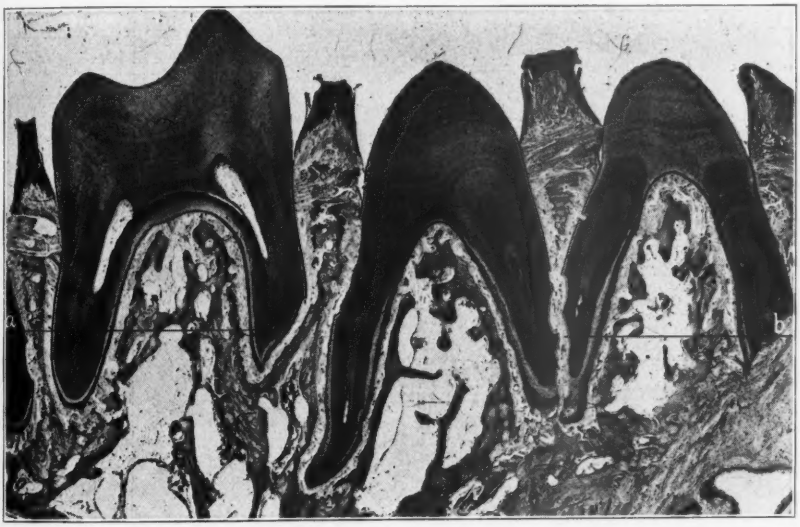

Fig. 9.—Molars of a monkey. *a-b*, repair after resorption on the roots.

The apex is resorbed, but the place formerly occupied by the apex is now filled with bone. The end of the resorbed root is covered by cementum. The periodontal membrane is normal. Another place in the same specimen marked by *b* is shown in Figure 10, a higher magnification. The two roots of the two teeth are apposed and have become resorbed. The resorption in this case may be due to pressure which took place as the two destroyed by this caries and the two teeth approach each other. Because of this wandering of the teeth, not only has the alveolar bone between the two become resorbed, but resorption has occurred also on the surface of the roots.

With these pictures, I have tried to show you different cases of resorption caused by different influences. It is not my intention to discuss the causes which may lead to resorption on the surface of

Fig. 10.—Higher magnification of Figure 9 at *b*. *a*, dentin of one root; *b*, dentin of other root; *c-d*, new cementum on the resorbed dentin; *e*, space between the two resorbed roots.

the root: I merely wish to show that the results of resorption due to any condition may be repaired if the cause is removed. The process of this repair is: deposition of cementum in the resorbed area; the embedding and so the attachment of new fibers to the surface of the root; new bone formation until the normal thickness of the periodontal membrane is reestablished.

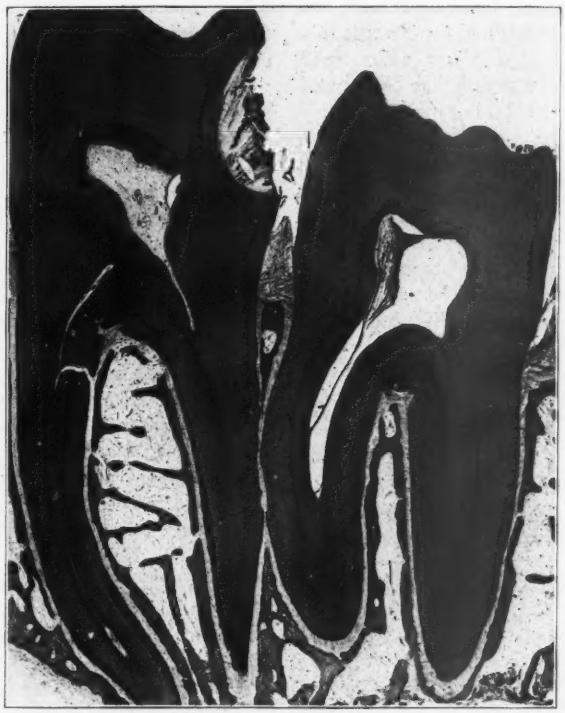

Fig. 11.—Resorption of the interdental septum and surface of the roots due to destruction of the contact point and the wandering of the teeth together.

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The short time I have at my disposal does not permit me to enter into discussion of the literature which covers these questions. A few papers, however, should be mentioned: B. Gottlieb's "Histologic Examination of a Healed Tooth Fracture," in *Zeitschrift für Stomatologie,* 1922, vol. 5; "Diffuse Atrophy of the Alveolar Bone," *ibidem,* 1923, vol. 4, and "Tissue Changes in Pyorrhea," in THE JOURNAL, 1927, vol. 12; J. Kohler's "The Growing Together of Tooth and Bone," in *Zeitschrift für Stomatologie,* 1927, vol. 9; W. Bauer's "Histologic Findings in the Teeth After Root Apex Amputation," *Zeitschrift für Stomatologie,* 1922, vol. 2 and 1925, vol 2; E. Kellner: "Histologic Findings of Teeth Without Occlusion," *Zeitschrift für Stomatologie,* 1928, vol. 3.

HISTOLOGIC STUDIES OF A SPECIMEN OF FRACTURED ROOTS*

By EARL P. BOULGER, D.D.S., L.D.S., Chicago, Illinois

THE knowledge of the changes that occur in and about a fractured root in the mouth has been based more upon the findings of extracted teeth than upon a histologic examination of the surrounding tissue. A review of the dental literature on this subject embraces a number of articles. John Tomes'[1] "Dental Surgery" mentions several cases of fractured roots which, when extracted, were found to be united. Bennett[2] reported a case in 1896, and Sir E. Saunders[3] also found an incisor which showed marks of united fracture. Owen[4] described the case of an united fracture in the tusk of a hippopotamus.

Newton G. Thomas[5] reported a case of fragments of two upper bicuspid roots and a part of a third molar, about which any history of value was lacking. These roots were sectioned and disclosed a deposition of cementum covering the fractured surfaces and extending over the primary cementum. The canal contained a tissue which "is not pulpal in character but is rather well-compacted fibrous tissue with a scarcity of cellular elements most of which are peripherally located."

H. C. Mallison[6] reported a case of an upper lateral incisor which had been fractured transversely at the alveolar margin. The tooth failed to respond to thermal changes and, being tender, was extracted. A secondary calcified material had been laid down in the pulp in the fractured area and at the sides of the pulp canal. The pulp chamber of the coronal portion of the pulp was empty, but the radicular portion of the pulp showed dilated blood vessels being filled with red corpuscles, and one or two small areas where there was some fibrosis.

Percy R. Howe[7] found a fractured upper central incisor in a boy 11 years old who had been hit by a swing board two years previously. The tooth was extracted and the histologic findings disclosed a repair of the fragments. A new layer of dentin had been deposited along the pulpal wall and cementum had formed in a fold at the point of fracture on one side of the root.

Many cases of fractured roots have been reported which give the clinical and

*Read before the Illinois State Dental Society, Rock Island, May 11, 1928.

*From the Research Department (Director, Balint Orban) of the Chicago College of Dental Surgery, Dental Department of Loyola University.

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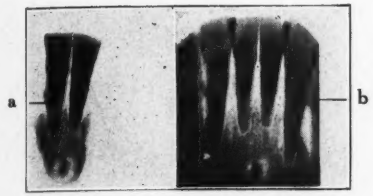

Fig. 1.—Roentgenograms taken for the case described. *a*, before operation; *b*, after surgical removal.

roentgenographic findings. Among the number who have brought light to bear on this matter as reported by R. Ottolengui[8] are Jacques M. Strully,[9] M. Cherney,[10] David Cohen,[11] George R. Warner[12] and Howard Raper.[13]

The most exhaustive report found in the literature was made by Bernhard Gottlieb.[14] The case consisted of an upper left cuspid and the root of a broken down bicuspid. The condition of the contents of the canals disclosed a complete lack of odontoblasts, and the pulp structure of blood vessels and nerves was torn. The canal walls were covered with cementum. Upon the dentin at the apex, a dentinoid layer had been deposited, and upon this, a layer of connective tissue cells could be seen. This dentinoid originated before the time of the fracture, when the odontoblasts were present.

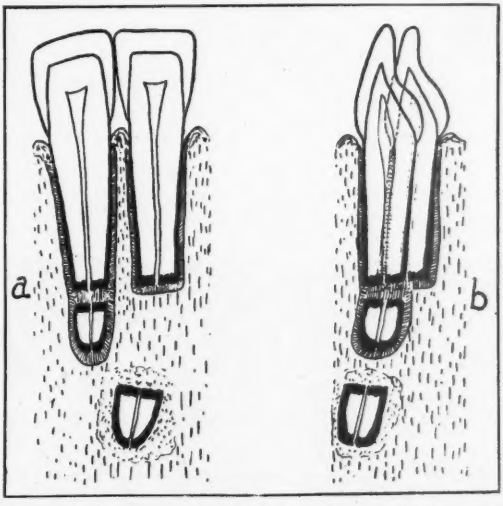

Fig. 2.—Diagrams of the specimen under discussion; made from roentgenograms and microscopic specimens. *a*, mesiodistal view; *b*, labiolingual view.

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Fig. 3.—Fractured roots of both central incisors. *a*, dentin; *b*, fractured apex of left incisor; *c*, secondary cementum deposited on the fractured dentin surfaces; *d*, root canal of right incisor; *e*, bone deposited on a place formerly occupied by the apex.

Fig. 4.—Higher magnification of the root-end of the right incisor. *a*, periodontal membrane; *b*, secondary cementum deposited on fractured end of the root; *c*, fractured piece of cementum lying in the periodontal membrane; *d*, bone in place formerly occupied by apex of tooth; *e*, primary cementum on the surface of the root.

In the more recent literature, O. Römer[15] has shown an unusual case of a fractured root which had been repaired.

With the exception of the article by Gottlieb, the publications up to this time have been based upon the findings of extracted teeth instead of sections of the surrounding tissue.

The case under consideration in this article was that of a woman, aged 45. The patient asserted that, at the age of 12 years, she fell downstairs and suffered an injury of the anterior teeth. The upper left central incisor became sore and, from the history, it was concluded that

Fig. 5.—Higher magnification of the fractured root end of the right incisor. *a*, secondary cementum covering fractured and resorbed dentin; *b*, dentin; *c*, cementum; *d*, cementum covering tear in primary cementum; *e*, periodontal membrane; *f*, bone on place of former apex; *g*, secondary dentin; *h*, pulp canal.

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an abscess formed, resulting in the extraction of the tooth some four years later. The patient suffered no further discomfort. It was disclosed in a roentgenogram, thirty-three years later, that the lower central incisors had likewise been fractured. The line of demarcation between the roots and the fragments was plainly discernible in both teeth in the roentgenogram. (Fig. 1.)

The right central incisor revealed the separated by a fine dark line which appeared as a part of the periodontal tissue.

There was no clinical evidence of any change in or about the teeth. The gum tissue showed some inflammation due to the presence of calculus and the teeth were of normal color. The electric pulp tester elicited a response similar in degree to that of the teeth on either side of those involved.

Fig. 6.—Higher magnification of area *b* of Figure 3. *a*, dentin; *b*, cementum; *c*, new, uncalcified cementum; *d*, periodontal membrane; *e*, pulp canal with fibrous connective tissue, blood vessels and bundle of nerve fibers.

fragment removed from the tooth a considerable distance. It was surrounded by an area that would commonly be classified as an area of resorption. The end of this root appeared normal roentgenographically, with the lamina dura and periodontium extending intact from one alveolar crest to the other. The left central incisor disclosed the fragment but slightly removed from the root and

Gottlieb[14] mentions the fact that, when the odontoblastic layer is destroyed, the tooth should not react to the electric current, regardless of whether the pulp canal contains a gangrenous pulp or is filled with cement building tissue. So we were led to conclude that a vital pulp was present.

The histologic findings corroborated those obtained by clinical and roentgen-

Fig. 7.—Low magnification of fractured teeth with the dislocated apical portion (*a*) of right incisor.

ographic examination. The roots of both teeth disclosed transverse fractures in the apical region.

For convenience in describing this case, it is found advantageous to adhere closely to a study of the sections as seen in the photomicrographs. A diagrammatic drawing (Fig. 2) of the specimen under consideration was made from the roentgenographic and histologic findings. From the mesiodistal aspect (*a*), the fragment of the left central incisor lies just below the root of the tooth, while, with the right central incisor, the fragment lies from 3 to 4 mm. below the end of the root. The labiolingual view (*b*) shows that the fragments are in a position labial to the fractured surfaces of the end of the roots.

The first histologic section (Fig. 3), an area about the ends of the roots, shows the repair that has taken place. The dentin (*a*) of the fractured surfaces of both the root and fragment (*b*) of the left central incisor has been covered with a deposit of secondary cementum (*c*). Not only is the periodontal tissue found between the alveolar bone and the root of the tooth, but a proliferation of this tissue has formed as well between the fractured surfaces. In the pulp canal of the fractured portion (*b*) can be seen connective tissue with bundles of nerve fibers. This is shown more clearly later, in a higher magnification. A piece of cementum which was broken from the root lies embedded in the secondary cementum covering the surface of the fragment. The right central incisor discloses a similar repair, and we can see the apical opening of the pulp canal which is filled with pulp tissue (*d*). The space previously occupied by the apex of this tooth is filled with osseous tissue (*e*).

A higher magnification of this area (Fig. 3, *d* and *e*) discloses the new bone development that has taken place to form the alveolus of what now may be considered the new apex of the root, the original apical end being found removed from its original position, as mentioned. (Fig. 7*a*.) Nature has further compensated for the injury in this case by a

proliferation of the periodontal tissue (*a*) for the end of the root to rest on and secondary cementum (*b*) to cover the fractured surface. Secondary cementum (*c*) has likewise covered the space previously occupied by the end of the root.

A still higher magnification (Fig. 5) of the area about the apex shown in Figure 4 discloses the lamellated form

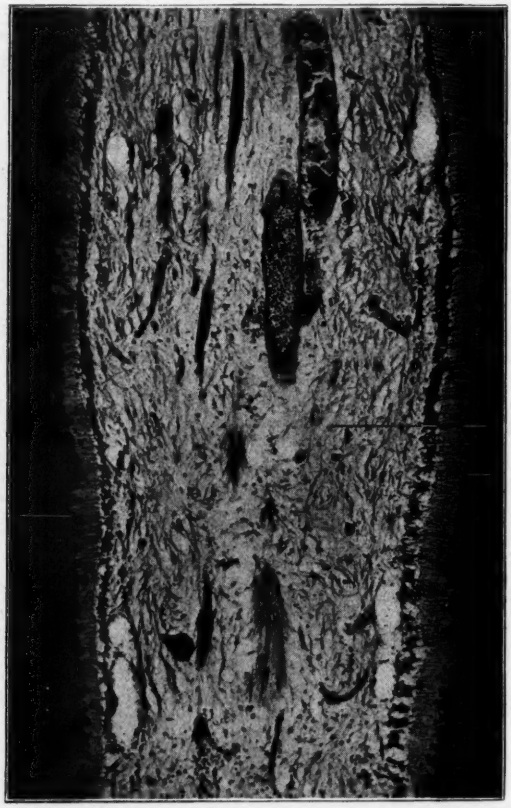

Fig. 8.—Pulp chamber. *a*, pulp tissue, no sign of inflammation, slight degenerative changes; *b*, odontoblastic layer; *c*, new, uncalcified dentin.

roughened surface of a piece of primary cementum which was broken away from the root. No cementum was to be found on the walls of the canal proper but sufficient was laid down to form a new apical foramen. Bone (*d*) now fills the (*a*) of the secondary cementum and the cement corpuscles, the remains of the cementoblasts which from their own activity have become embedded in the cementum. Along the fractured surface of the dentin (*b*) can be seen the la-

cunar resorption of this tissue in preparation for the deposition of cementum. As Gottlieb[14] notes, not all bone or dentin is favorable for implantation, clasts before a deposition of cementum occurs.

In a higher magnification (Fig. 6) of the fragment of the left central incisor

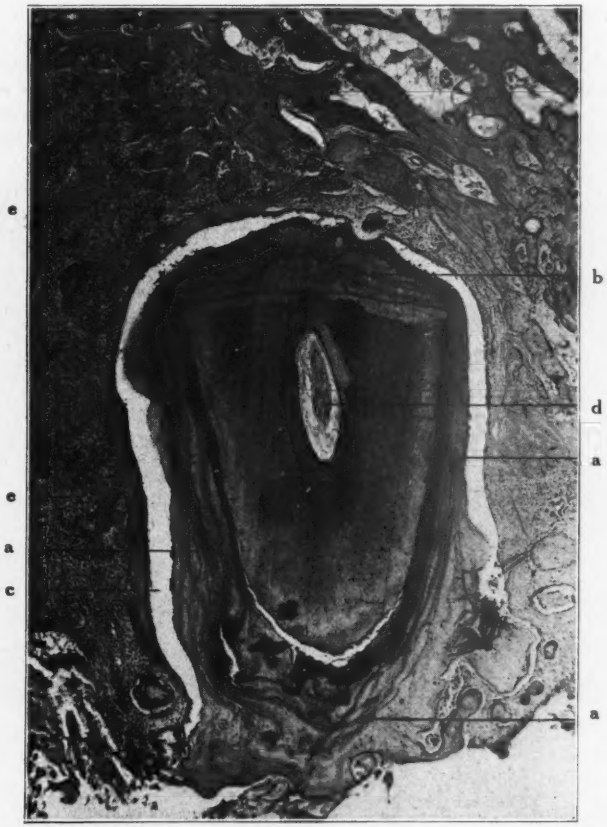

Fig. 9.—Higher magnification of apex shown in Figure 7 (*a*). *a*, cementum around apex; *b*, secondary cementum on the fractured dentin surface; *c*, artificial space, probably due to trauma of surgical removal; *d*, pulp canal with new fibers; *e*, scarlike connective tissue around the apex.

meaning the deposition of cementum on a surface, namely, the organic connection of a tissue with surrounding tissue, and that the portion possessing lessened vitality is usually cleared away by osto-

shown in Figure 3 *b*, we see the dentin (*a*), the primary cementum (*b*), the uncalcified cementum (*c*) on the surface, indicating a new building of cementum at the time of the removal of

the specimen, and the periodontal membrane (*d*). In the pulp canal (*e*) is connective tissue. This connective tissue has replaced the original pulp tissue and contains blood vessels and nerve fibers which are plainly discernible. It was possible that, as the fracture occurred, the tissue in the root canal of the fragment might become degenerated or necrotic; but as we see after many years, no sign of degeneration or necrosis can be noted.

bone formation can be seen more clearly in this section, filling the space, formerly the location of the fragment, and further removed is noted the fractured portion (*a*) of this root, which, owing to its labial position, shows in this oblique section. This fragment may have been driven deeper into the tissues by the impact of the blow, or it is possible that it may have remained in its original position and the tooth over this period of

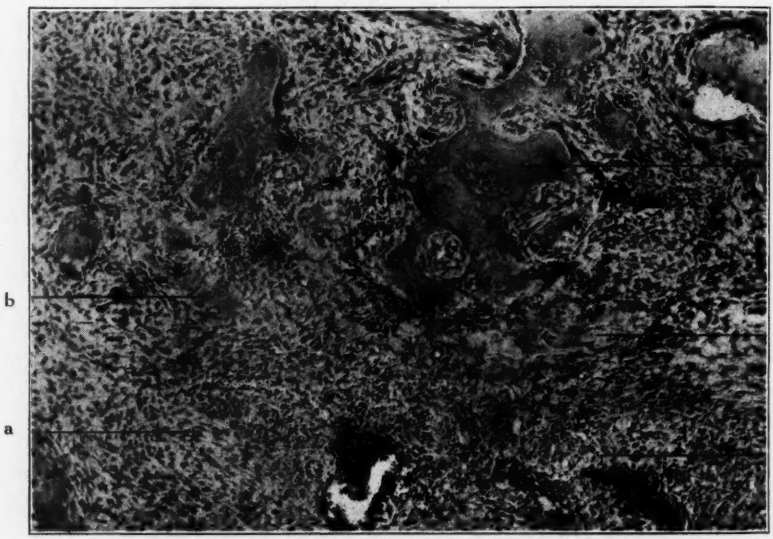

Fig. 10.—Higher magnification of area *e* of Figure 9. *a*, scarlike connective tissue with hyaline degeneration in places (*b*); *c*, new bone formation.

If necrosis occurred, it must have been resorbed and replaced by fibrous connective tissue. The narrow root canal and large amount of secondary dentin around the canal rather indicate that the pulp did not become necrotic but functioned and slowly became fibrous.

A section which has been cut diagonally through the length of the roots (Fig. 7) discloses the pulp canals of both teeth with the pulps intact. New

years may have moved upward to compensate for the abrasion of the incisal surface.

The pulp tissue (Fig. 8) shows a slightly atrophic condition as is generally found in patients of this age. The embryonic connective tissue of the pulp (*a*) assumes a more fibrous nature as the patient becomes older. The presence of an odontoblastic layer (*a*) lining the walls of the canal is indisputable evi-

dence of the vitality of the organ. Along the pulpal wall is found a layer of uncalcified dentin (*c*), a product of odontoblasts. Hitherto, it has been thought that a slight injury would usually cause the disintegration of the odontoblastic layer. In the stroma of fibrous connective tissue can be seen blood vessels and bundles of nerve fibers. Of particular significance is the fact that all evidence points to the vitality of the pulp, which is free of inflammatory changes and necrosis.

The fragment of the left central incisor is seen in Figure 9. Secondary cementum (*a*) almost completely surrounds its entire surface, covering both the fractured surface of the dentin and the primary cementum. In the removal of the specimen from the mouth, a cut was made just below this fragment and a tear (*c*) is seen in the section, due to

Fig. 11.—Lower border of apical fragment. *a*, nerve bundle entering pulp canal (*b*); *c*, resorption of dentin; *d*, new building of cementum; *e*, bone around apex.

the operation. The pulp canal (*d*) extends the entire length of the fragment, but is seen in the picture as an oval space owing to the oblique plane of the section. It is filled with connective tissue, in which bundles of nerve fibers are discernible. The whole fragment is surrounded by a scar tissue formation (*e*). The connective tissue (*a*) as seen in a higher magnification (Fig. 10) has undergone hyaline degeneration (*b*). Areas of calcification can be seen, and the building of bone is discernible in some places. This tissue disclosed no areas of inflammatory change or necrosis.

Fig. 12.—Upper end of apical fragment. *a*, new nerve bundles (live canal); *b*, secondary cementum covering fractured root end; *c*, dentin; *d*, resorption line between dentin and newly deposited cementum; *e*, primary cementum; *f*, bone surrounding the apex; *g* artificial space.

At the lower border of this fragment (Fig. 11) is found the opening of the apical foramen (*a*), entering which can

be seen bundles of nerve fibers (*b*). Resorption of the dentin and cementum (*c*) can be seen, no doubt due to the pressure of these nerve fibers; while opposite this area is noted new cementum formation (*d*). The connective tissue that fills the canal is emitted through an opening (*a*) on the superior surface of the fragment (Fig. 12). The secondary cementum (*b*) is not only deposited on the fractured surface of the dentin but lines the wall of the canal at the opening. The pulp tissue that primarily filled this canal has been replaced by connective tissue, the cementoblasts of which have laid down this secondary cementum. Before this deposition on the fractured surface, slight resorption of the dentin took place. The border line between the dentin (*c*) and the cementum (*b*) shows lacunar resorption (*d*).

It has been shown by Gottlieb[14] that repair occurred where there was no evidence of vitality of the pulp, and likewise in the report of experimental root amputations on cats conducted by W. Bauer,[16] who demonstrated that, on the amputated surface of the end of a root similar repair occurred.

CONCLUSION

The study of this specimen demonstrates the effort that Nature has made to effect repair after injury. This repair is shown in the deposition of cementum on the fractured surfaces and reestablishment of a normal periodontal membrane, which permits a normal function. The significance of the presence of a vital pulp leads us to conclude that the injury does not always impair the vitality of the organ, in spite of the fact that the odontoblastic layer is very susceptible to any form of trauma.

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CLINICAL REPORT OF AN UNERUPTED THIRD MOLAR

By T. J. GEREN, D. D. S., Groesbeck, Texas

MR. B, a lawyer, aged 51, had enjoyed good health all of his life with the exception of an attack of appendicitis in 1920, for which a successful operation was performed.

He began to fail in health about the first of 1925. During the year, he was very nervous and suffered severely from melancholia and insomnia. At times, it was necessary to resort to opiates in order to obtain sleep. The patient was very irritable with both his family and his closest friends.

He got to the point where he had lost interest in business, and preferred to spend most of his time alone. His face had an expression of awe and had begun to wrinkle. His condition caused him much anxiety, and he sought medical attention, having his tonsils removed but to no avail. In November, he had an attack of sciatica of the left leg with a partial paralysis of the leg which at this time confined him to his bed for about three weeks.

Dec. 1, 1925, while he was in the hospital, I was called to make an examination of the teeth. I found that he had no cavities, and the gums were not involved. All the teeth had erupted except the left lower third molar, and on making roentgenograms, I found the molar sitting almost straight but tilted slightly distally, a considerable amount of bone being over the occlusal surface.

Feb. 1, 1926, I removed the tooth surgically, using conductive anesthesia. A cyst larger than the tooth was embedded in the angle of

the jaw. On removing and opening the cyst, which was in a bladder-like substance, an almost unbearable odor was evidenced.

There had never been one particle of pain in or around the teeth or jaw, and the patient had not even suffered from headache. Recovery was immediate. The patient's health is fully restored. He seems to have a new lease on life, and is at this time enjoying excellent health.

EXTRACTION OF TEETH AND REMOVAL OF SUSPICIOUS FOCUS OF INFECTION: REPORT OF CASE

By A. J. HYDE, D.D.S., Pittsburgh, Pa.

THE patient, aged about 60 years, was admitted to the hospital with hypertension and cardiac disease.

Although several other teeth were extracted, the one I wish to call particular attention to was an upper right second molar. This tooth, which one might call a freak of nature, was placed in the jaw in a perfectly normal position, but, on extraction, showed a distinct abscess at the root of the second molar, whose roots were fused.

Fig. 1.—Position of teeth in the jaw.

When the tooth was extracted, it was noticed that a long portion attached to the root of the second molar was present. At first, I thought that this might have been a cyst, but, on examination, it was shown to be a third molar perfectly fused to the roots of the second molar and extending perpendicularly to it. The second molar had been extirpated and used as an abutment for a bridge.

Previously to the extraction of this tooth, the patient complained of a stiffness on the right side of the neck and severe headaches. These conditions were relieved about three weeks after the operation.

The roentgen-ray department at the hospital where the picture was taken complained that the patient did not hold the film still and, for this reason, they thought, the roots

Fig. 2.—Appearance of teeth after extraction.

of the second molar showed an elongation. This, of course, was proved wrong when the tooth was extracted.

This case is reported in order to show the varied course nature takes in her development of the teeth. Accompanying is the roentgenogram showing the position of these teeth in the jaw previous to extraction, and a photograph of the teeth extracted.

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C. N. JOHNSON, Editor

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Editorials

THE SWING OF THE PENDULUM

The question of the pulpless tooth is still with us, but it is much nearer a solution than it has been for several years, and there is evidence of greater sanity in its consideration. There was a time when the name of the pulpless tooth was anathema in the land, and he who had the temerity to suggest that such a tooth might be saved was held up to scorn as an enemy of the human race.

There were extremists among dentists and particularly among physicians—men who could not be convinced that it was ever safe to leave a pulpless tooth in the mouth no matter how carefully it was treated. Just why a well filled pulpless tooth should have been considered an undoubted menace, it is difficult to understand, in the face of the clinical fact that countless numbers of such teeth have been retained in the mouths of patients for many years, to their great benefit and without the slightest evidence of any harm; and the other clinical fact that so many of these teeth have been

extracted for patients for the alleviation of systemic trouble, and no relief whatever has followed. It is true that we have evidence, apparently in rebuttal, of other cases in which the extraction of teeth has resulted in relief of systemic symptoms; but, in many of these cases, the relief has been largely psychologic, as evidenced by a future return of the systemic ailment long after the loss of the teeth.

An accumulation of such cases has caused the thinking men of medicine and dentistry to pause, and to display a greater conservatism in their attitude toward the question of the pulpless tooth. An evidence of this may be found in the May 26, 1928, number of *The Journal of the American Medical Association*. In the "Queries and Minor Notes" department of that issue, we find the following:

DIAGNOSIS OF INFECTED TEETH

To the Editor:—Please send me information on the following points: 1. Value and limitations of roentgen-ray diagnosis of dead teeth as to presence or absence of infection. 2. Effect of the presence of a dead tooth (foreign body) on adjacent tissues and the general health if there is no infection. 3. Modern medical opinion regarding the filling of root canals, crowns, peg-teeth, drainage of apical abscess and later filling root canals. 4. Value of transillumination in the diagnosis of apical infection.

M. D., Iowa.

Answer.—1. The roentgen ray is of no value in diagnosing teeth with dead pulps except in those cases in which infection, following the death of the pulp, has penetrated and destroyed bone about the apex of a root. The roentgen ray does not show infection of bone, but reveals an area of bone which may have been destroyed by infection or otherwise.

2. There is no such thing as a dead tooth unless it has been extracted. A tooth from which the pulp has been removed is often spoken of as a dead tooth. The pulp occupies the internal canal of the tooth, while the attachment of the root to the bone (peridental membrane) is an entirely separate tissue and may be vital regardless of the vitality of the pulp. A tooth from which the pulp has been removed may not present any menace to the patient.

3. This is answered in number 2. There are records of many thousands of cases in which pulps have been removed and root fillings made which, from all the evidence available, do not show any sign of infection after many years.

4. Transillumination is not generally considered satisfactory for the diagnosis of apical infection.

This answer published in a representative medical periodical is most illuminating. It has a ring to it as if it had been written

by either a medical man or a dentist who had been long associated with a study of the pulpless tooth, and who knew the value or lack of value of roentgen-ray evidence. When this most important adjunct to our diagnostic service was first introduced, it was considered infallible as a means of determining the presence of infection or abscesses around teeth; but as its unreliability for this purpose became more and more apparent, it was soon relegated to its proper function by thinking men, and since then it has been accountable for less damage. It should be repeated once more that the roentgen ray does not show an abscess, or pus, or infection of any kind; and when this is recognized, and a more intelligent application of its real function is made, the professions and the people may well commend it for its manifold blessings and not be called on to suffer so much from its limitations.

Another angle to the pulpless tooth question has received much illumination of late. The assumption has generally prevailed that if the pulp canal was not filled to the apical end, there was always the menace of infection, that the space thus left was not only a potential but also a positive source of trouble, and that the only safeguard against future disaster was to remove the root filling and make a more complete operation by reaching the apical foramen. No recognition was ever made of the possibility that Nature might meet the situation and take measures to safeguard the tooth by filling the empty root end, and thereby protect it.

Any one making such a suggestion during the peak of the pulpless tooth rage would have been laughed to scorn as a visionary, even though clinical evidence went to indicate that Nature took care of many of these cases. But now we have something to supplement clinical evidence in the form of demonstrable scientific evidence. If the reader will refer to the paper of Dr. Edgar D. Coolidge in this issue, he will see portrayed some of the possibilities of Nature's effort to safeguard pulpless teeth, and he will note how unfilled spaces are sometimes closed by Nature in such a way that infection is prevented.

This is in no sense an argument for carelessness in the treatment of pulpless teeth, nor is it meant to condone slipshod methods

in dental operations; but it is at least comforting to know that if we put forth our best endeavors, Nature will not stand idly by and see our efforts set at naught without an attempt on her part to assist us with the protection of her beneficent function.

Neither man nor Nature can successfully cope with one hundred per cent of pulpless teeth, but that a vastly greater number may be saved in the future than have been saved in the past is perfectly apparent from a study of clinical and scientific evidence.

We are inclined to agree with Dr. Coolidge when he sums up his observations as follows:

"A comparison of roentgenograms with histologic sections shows that it is not necessary to extract all teeth showing periapical disturbances, nor to sacrifice all teeth with imperfectly filled root canals."

To make a statement like that a few years ago would have been perilously near to heresy, but to make it now with the evidence at hand to support it is only ordinary common sense. And after all, common sense should be the ruling factor in all of our professional procedures.

COMMITTEE ON THE COST OF MEDICAL CARE

Recognizing the fact that the cost of medical and hospital service to the average individual is fast becoming almost prohibitive, a committee was organized in May, 1927, for the purpose of studying the situation and obtaining as much light on it as possible. There is no intimation that professional men, whether physicians or dentists, are overpaid. In fact, it is agreed that many of them are sadly underpaid; and yet there is a discrepancy somewhere in the situation that needs to be cleared up. People in moderate circumstances must receive necessary service for a remuneration within their means.

As stated by Dr. Olin West, secretary of the American Medical Association: "The one great outstanding problem before the medical profession today is that involved in the delivery of adequate, scientific medical service to all the people, rich and poor,

at a cost which can be reasonably met by them in their respective stations in life."

This same statement may well be made of dental service, though the application to dentistry is not so acute as to medicine, for the reason that the issues of life and death do not so frequently confront dentists as they do physicians, and people are not compelled to go to dentists with the same urgency.

The committee does not promise to suggest any remedy, nor does it aim to intrude its opinions on professional men: it is merely looking for facts. And it has started with a five-year program, showing that it does not underestimate the magnitude of its task.

At first, the committee was small, but it is now composed of forty-two persons, most of whom hold the M.D. degree. There is one dentist, and there are economists, public welfare workers, etc. The chairman is Ray Lyman Wilbur, M.D., president of Stanford University, Calif., and the headquarters are at 910 Seventeenth Street, N. W., Washington, D. C.

This study will be watched with great interest, not only by professional men but also by the people at large, in whose behalf chiefly the investigation is being made. It is hoped that, in the end, some plan may be worked out whereby professional men may be adequately compensated for their service, and at the same time the people may be served within their means.

Under present conditions, this may seem like a contradiction of ideas; and yet more difficult problems than this have been solved in other activities of life, and there is no reason why this one should be insurmountable.

CHARACTER BUILDING

Building of all kinds is interesting. To lay the foundation of a house, to see a structure develop that is to be the home of those we love, or that some one else loves, to see the thing take form, the walls go up, the roof cover it, the rooms so arranged as to furnish the greatest convenience—how much delightful study those same rooms have occasioned—even to see the basement planned, mayhap

in latter days for a garage, in any event for a furnace to keep out the chill of winter—to see all of this maturing and giving promise of comfort and happiness in the days to come—this is a joy unapproached by any of the other material things of life. To build is to consummate, to produce, to achieve. Building is constructive and creative—it is even inspirational. There is no other of the practical occupations of human experience that brings more satisfaction than building.

If this much may be said of the construction of edifices, what shall be said of the building of character? To mold a human entity into a life of usefulness is one of the sublimest achievements. To take a girl or boy with all the myriad manifestations of inherited impulse; with tendencies that trace back to generations long since forgotten; with all the innate irresponsibility and even the waywardness of youth; with the surgings and the well-nigh uncontrollable desires and longings that well up in the developmental period from young girlhood and boyhood to womanhood and manhood; with the ulterior influences that inevitably surround society in this modern complex life; and to overcome the handicap of heredity and environment—to do all of this and do it with charity and loving kindness; to open the heart to every girl and boy and guide them with sweet concern; to win their confidence, their respect and their love—to do this as an accepted and sacred duty and do it with pleasure, even with joy, is merely to fulfil one of the fundamental obligations of life.

To build character is better than to build houses, and infinitely more interesting—to build a house is not necessarily to make a home. Something more is needed than brick, and stone, and mortar, and wood and paint to make a home—something more is needed than flesh, and blood and bone to make character. It takes love to illumine a home, and it takes love and something more to make character. A girl or boy may be lovable and yet lack in some of the essentials of character. It requires certain of the sterner virtues to comprise character. It requires strength of purpose and rock-ribbed honesty; it requires courage of convic-

tion, and clearness of vision; it requires stability, steadfastness and self-sacrifice.

Certain lessons must be learned by the young man or young woman who would acquire the attributes of character. Chief among these is the elemental fact that every individual must be held strictly accountable for his own actions. Let every boy and girl learn this one lesson; let it sink into their consciousness as the deepest conviction of life; let them repeat daily the actual words and absorb in their very souls the essence and spirit of this principle, and they will need no other monitor to guide them in their daily lives; because in this idea there lies the profoundest truth, and the germ of the sanest and best philosophy.

There is in life no vicarious provision whereby one person may assume or accept restitution for the misdeeds of another. The wrongdoer can get no one to go bail for him when the misdemeanor is a moral one. Peccadillos do not count in this category, but a breach of principle always brings its own retribution. Character makes no compromise with criminality, and every individual of responsible age knows whether an act is right or wrong. There is no shirking the issue, no blinking at facts.

To build character, we must begin at the foundation and be sure of every plank in the structure. We cannot mortise the sound timbers of equity and justice with the faulty tenon of dissembling and equivocation. There is no substitution or evasion in the making of character, no hedging of the essential elements of probity and correct living. Every act is stamped indelibly on the consciousness and even on the conscience, and no sophistry can erase it. No matter how unpleasant a fact may be, as long as it is a fact it must be reckoned with. The requisites for making character are very simple, but they are as irrevocable as the law of gravitation, as exacting as the rules of geometry. To the extent that they are violated, to that extent is character marred.

All of this does not mean that harsh or severe measures must be taken in the making of character in a girl or a boy. To hold the rod over youth does not contribute to character building. Forced obedience to rules does not make for assurance of good

behavior, any more than leading a horse to water can guarantee that he will drink. Encouragement, kindness, consideration and persuasion will go farther in building character than all the coercion that can be practiced. Make no mistake: you will win a girl or boy with sympathy more certainly than with censure. No one was ever made really good with a club.

And be assured of one other fact: you cannot successfully build character in others unless you possess character yourself. How can you look a girl or boy in the face and ask them to be good if you are lacking in goodness yourself? It cannot be done; they will see through you instantly. There is nothing more certain in all human experience than that the one thing you cannot conceal is lack of character, any more than you can conceal the possession of character.

MEYER L. RHEIN, M. D., D. D. S.

(1860-1928)

Meyer L. Rhein was born in Albany, N. Y., Jan. 31, 1860. He died July 16, 1928, of an acute asthmatic attack, at his home at 38 East Sixty-First Street, New York City.

Dr. Rhein received the degree of doctor of medicine from Albany Medical College in 1880. A year later, he received the D.D.S. degree, from the University of Pennsylvania, where he has been identified with the department of dental pathology as a lecturer. He also studied and lectured in Vienna and other European centers.

He was a member of the American Dental Association, the American Medical Association, the United Dental Society of Germany and the Vienna Dental Society.

Dr. Rhein originated the porcelain root for replacing the amputated root; a method of fixation of loose teeth, and a technic for filling pulpless teeth. He was the first to apply the principles of ionization to dentistry. He was also the author of many articles covering various phases of dentistry.

Mrs. Rhein and two daughters survive.

MEYER L. RHEIN, M. D., D. D. S.
(1860-1928)

BUREAU OF DENTAL HEALTH EDUCATION

OPERATIVE DENTISTRY FOR CHILDREN*

By F. BLAINE RHOBOTHAM, D.D.S., Chicago, Ill.

CONTRARY to the general opinion that children's dentistry consists of a few simple extractions of deciduous teeth and the placing of semi-temporary cement fillings, its rational practice consists of the most complicated dental problems. Initially, it is concerned with the puzzling consideration of the physiology of calcium fixation and with the effects of early disease on dentition.

In infancy and throughout babyhood, we are confronted with abnormalities of function, of habits and of heredity. Because of the lack of importance placed on children's dentistry, too often scientific treatment is neglected beyond the time of usefulness. Proper information is not given at the opportune time. Just how unfortunate the consequences may be is attested by later malformations.

To appreciate the complications of dental problems during childhood, we must consider that this phase of life comprises the periods of formation of the deciduous tooth; of the calcification of the permanent set; of the influence of habits on facial development, and of the eruption and fixing of the second teeth, and the general directing of the building and maintenance of the dental arches.

To cope intelligently with a situation so pregnant with possibilities for good or evil requires the last word in dental knowledge.

*Read before the Section on Operative Dentistry at the Midwinter Clinic of the Chicago Dental Society, Jan. 24, 1928.

In practicing dentistry for the adult, our problems are largely reparative and are limited to the maintenance of whatever may result from conditions of childhood. To practice dentistry for children, we have added to reparative dentistry a myriad of duties to perform (under adverse conditions, many times). Only one of these duties is preventive.

The examination of a child's mouth requires a thorough understanding of all phases of dental development, of dental pathology and of the operative dentistry that pertains to the case in hand. In no place in dentistry is there such a need of the roentgen-ray as in a clinical examination of a child's mouth. By means of the roentgen-ray may be determined physiologic development or absorption; pathologic conditions of root ends; noneruption of permanent or temporary teeth; absence of teeth; the presence of supernumerary teeth, etc. The roentgen-ray reveals the size of the pulp chambers and makes efficient operative procedures possible.

Although proper diagnosis and thorough familiarity with each case are difficult, they are absolutely essential to the success of dentistry for children.

The foregoing is dedicated to the principle of placing children's dentistry on the pedestal of importance that it deserves and to dignify, if possible, the following remarks, with an appreciation of the seriousness of the subject.

CAVITY PREPARATION

The equipment for cavity preparation for children's teeth should include everything that is used for adults, for, during this period, we have to deal with all the permanent teeth (third molars excepted). We must remember, however, that the deciduous teeth require special handling. These differences will be taken up in order, but a suggestion may be made that, because of the added sensitiveness of young permanent teeth and because of the child's natural fear of pain, the cutting instruments should be kept sharp, and the burs should be very small and graded, several changes being made in opening cavities; also a free use of small mounted stones is indicated.

(*a*) *Proximal Surfaces of Anterior Deciduous Teeth*—In large teeth with normal separation by bone development, the same technic pertains as in permanent teeth. In small crowded teeth, the proximal surface should be filed away at the expense of the proximolingual angle and the exposed dentin treated with a saturated solution of silver nitrate, precipitated with eugenol. This treatment should be repeated at intervals of three months until caries is under control.

(*b*) *Proximal Surfaces of Permanent Anterior Teeth*—If there is a prevalence of decay in patients from 7 to 12 years, the rubber dam should be placed, all of the caries removed, extension for prevention practiced when possible, and the tooth filled with a good zinc cement filling or the pulpal wall covered with zinc cement and synthetic porcelain used to complete filling. These cases should be checked at least three times yearly and kept in order, so that a permanent filling may be placed after the twelfth year.

(*c*) *Proximal Surfaces of Deciduous Molars*—Care should be used to prevent exposures due to the relative thickness of the enamel and to the thinness of the dentin. Usually, the cavity should be carried onto the occlusal surface, except in cases in which the cavity can be prepared without materially weakening the occlusal enamel. In a few rare instances, the proximal surface may be treated as suggested for the anterior teeth, provided the contact is not destroyed.

(*d*) *Proximal Surfaces of Permanent Molars*—In children under 11 years, roentgen-ray films should be used to determine the proximity of the caries to the pulp. In cases of slight cavity below the contact point on the mesial surface of the first permanent molars, with perfect access, a cavity may be prepared without carrying it onto the occlusal surface.

(*e*) *Occlusal Surfaces of Deciduous Molars*—In children under 8 with susceptibility to caries, fissures should be carried out. In children over 8 with natural immunity to caries, cavities need not be so extensive in every case.

In deep cavities that are sensitive, caries is treated by soaking with eugenol, followed by silver nitrate at the same sitting. This is sealed in and left in as treatment. The operator then excavates around the cavity to the depth of the caries, with burs directed toward the cemento-enamel junction and with no attempt to remove the bulk of the caries. The remaining caries is lifted out in layers with large spoon excavators.

(*f*) *Occlusal Surfaces of Permanent Molars*—The procedure in this case is similar to that of deciduous teeth, except that, if silver nitrate is to be used, the outer walls should be covered with cement to prevent discoloration. In children under 12, the floor of the cavity of all first permanent molars should be covered with a thin layer of zinc cement before the metallic filling is placed. In deep cavities, whether they have been

painful or not, a treatment should be placed for a time before a permanent filling is placed. In developmentally defective fissures or pits in very young patients, the cavity may only include defective areas, and instructions may be given for future examinations and care, if necessary. The rule in most cases should be to practice extension for prevention.

(*g*) *Special Cases*—Deciduous cuspids with large mesial and distal cavities in children under 10 should be excavated to remove caries and should be covered with platinum or gold crowns.

Atrophied first permanent molars should be restored to normal shape and size by cast gold inlays, properly occluded.

(*h*) *Class III Cases*—These need not be discussed because the technic suggested above for all cavities can be borne in mind when using the known methods.

FILLING MATERIALS

(*a*) *Gold Foil*—There is little use for gold foil in deciduous teeth. It is particularly adapted to lingual pits in permanent lateral incisors in children over 10 years of age, in small buccal pits of first permanent molars, in simple occlusal pits of upper first permanent molars, in simple occlusal cavities of bicuspids in children over 12. Its use in proximal cavities of anterior permanent teeth should be discouraged in children under 12.

(*b*) *Gold Inlays*—Gold inlays should be used in lower first permanent molars in children over 9 years, after the precaution of covering the pulpal walls with a thin covering of zinc cement has been taken and after due treatment has proved the normalcy of the pulp.

They are also indicated in large occlusal cavities of the same teeth at proper age.

A poorly fitted inlay is no better than the cement that holds it in place, and during childhood, when caries is prevalent, exceptional care should be exercised.

Gold inlays are of exceptional value in compound cavities of deciduous molars, in cases in which normal contacts need to be preserved and in which there is a great loss of tooth substance, making the use of amalgam impracticable.

(*c*) *Silver Amalgam*—This filling material is the most satisfactory of all for deciduous molars, but requires the same careful handling for these teeth as for the permanent teeth. If properly manipulated, entire crown portions of atrophied first permanent molars may be restored.

(*d*) *Copper Amalgams*—Much praise has been given copper amalgam because of its ease of adaptation and its supposedly germicidal qualities, but these virtues are largely overruled by the time required for its setting, the fact that it gradually washes out and its color. Its usefulness is limited to the deciduous molars, and there it is inferior in most cases to silver amalgam.

(*e*) *Zinc Cement*—There are many inferior grades of zinc cement, but, if carefully selected, it is a very satisfactory material. It has been known to last for many years in some mouths where it has been used as a semi-permanent filling. Much depends upon how it is mixed and used. If used over sensitive dentin, the addition of a little eugenol will make it less irritating. It is thereby weakened and should be covered by a mixture without the oil, if it is to be exposed to the fluids of the mouth.

(*f*) *Copper Cements*—Black copper cement, by far the most lasting of all cements, has the faculty of adhering to cavities when there is little if any reten-

tion preparation. It is highly irritating and should not be used near the pulp. In mouths in which there is a great susceptibility to caries, it is a valuable protection in fissures and pits. In most cases, it requires replacing from time to time.

Copper cement is capable of sterilizing the surface with which it comes in contact, but it does not penetrate, and therefore should never be used to cover up carious dentin.

Red copper cement of the proper selection is also a valuable filling material for badly broken down deciduous teeth and adheres well in shallow cavities. It also has a sterilizing action on the surface but, like black copper, will not penetrate.

The copper cements last well and are useful in teeth that need only to remain in the mouth for a period of months or a few years at most. In the latter case, they usually must be replaced from time to time.

(*g*) *Synthetic Porcelain*—This material is exceptionally dangerous in young permanent teeth or near the pulp of any tooth, because of the irritating effect of the acid liquid with which it is mixed. In any event, it is more or less temporary and calls for careful reexamination. Zinc cement should always protect the pulp of teeth in which it is used. If carefully manipulated, it has its uses in children's dentistry. There is a synthetic porcelain on the market now that may be used in deciduous molars. This has some value in its endurance and strength and has possibilities that may prove worth while.

ROOT CANAL THERAPY

The treatment of root canals of deciduous teeth should be limited to cases among children in the best of health when examination shows complete physiologic development, lack of pathologic or physiologic absorption of roots, and lack of absorption of pathologic tissues about root ends, and when frequent subsequent examination both clinical and by roentgen-ray can be made.

The root canals of deciduous teeth may be filled by any of the approved methods for root canal fillings, with a suitable paste used in the molars to which access is difficult.

Root canal therapy for permanent teeth during childhood is limited to selected cases in which the roentgen-ray shows fully developed roots. The practice of pulp amputation, with the hope of keeping the apical third of the pulp alive, to make possible the completion of calcification of the root ends, is too much in the experimental stage to be generally recommended. There have been many successful reports made of this treatment, however.

If there is ever a time in the human span of life that care should be of the highest precautionary type as regards focal infections, it is during childhood. Therefore, all operative procedures should be made with that thought in mind. Health and its preservation is the highest duty of our profession, and every effort should be tempered with that standard in mind.

25 East Washington Street.

DENTAL DISPENSARIES IN SAN FRANCISCO

By JOHN E. GURLEY, D.D.S., F.A.C.D., San Francisco, Calif.

THE demand and the need for dental service continues to grow, and if we as a profession are going to cope with the public need, it behooves us to look well to the establishment of dispensaries where a large volume of work can be handled.

The work of children's dentistry alone is beyond the reach, range and possibility of accomplishment by individual dentists. It is a matter of community interest and, to a large extent, community business.

Therefore, there should be a well established dental center in close connection with the public schools, under the direction of either the board of education or the board of health.

In addition, there should be other centers, possibly under the direction of the outpatient departments of hospitals, where both children and adults can be served, and at a cost within the limits of their ability to pay, or where patients may be cared for even without cost. Surely this is essential from a purely scientific, if not humanitarian, point of view, in order that a greater step in the field of prevention may be made.

There are two great needs confronting the dental profession today: first, service to those who have experienced and are experiencing dental disorders, which means reparative work of all kinds, for both children and adults; and secondly, an even greater need of service for our children, out of which will come no small release from dental disease when the period of adulthood is reached. The latter involves some reparative work, especially on the deciduous teeth, but just as we preserve our potatoes by sprouting them in the late season, or our apples by keeping them clean and cool, so will we preserve the permanent teeth by attention to the deciduous set.

In San Francisco, we are making an effort to do our part as the following list of dispensaries will indicate. A short description of the nature and the work accompanies the name of each dispensary.

SURVEY OF DENTAL DISPENSARIES IN SAN FRANCISCO[1]

Department of Public Health (1085 Mission Street): Has four dentists at the board of health offices. Five schools, one dentist each. Two health centers, one dentist and two dental hygienists. Prepared to carry out treatments and extractions and place cement, amalgam and silicate fillings. All dentists working on salary paid out of board of health budget. Service free to children attending school.

University of California, College of Dentistry (4th and Parnassus Streets): Routine dental clinics. Capacity, 100 units. Training school for dental hygienists. Field work permitted in various schools and orphanages. Charges, fee schedule based on cost analysis.

College of Physicians and Surgeons, School of Dentistry (344 Fourteenth Street): Routine dental clinics. Ca-

1. Made by Miss Edna J. Shirpser.

pacity approximately 100 units. Fee schedule based on an analysis of the cost.

Stanford University Clinics (Sacramento and Webster Streets): One unit operating three times a week. Practice limited to extractions, dental surgery and children's fillings.. Charges part pay. Staff consists of eight volunteers and two dentists on salary. Only patients in Stanford Hospital and outpatient department are eligible.

Letterman Hospital (Presidio Reservation): Operates five units. Employs four dentists on salary. Working six days a week. All types of dentistry are available. Cares for officers and privates and their entire families without charge.

Children's Hospital, Outpatient Department (3700 California Street): Operates two units full time. All types of dentistry for women and children are available. Staff consists of seven volunteers and six dentists on salary. Charges arranged by social service department. Training school for dental office assistants.

St. Luke's Hospital (Twenty-Seventh and Valencia Streets): Operates one unit. Employs one dentist one-half time. Practice limited to general dentistry of adults and children. No gold work or orthodontia.

Mary's Help Hospital (145 Guerrero Street): Operates four units, daily from 9 a. m. to 12 m. Does general dentistry and orthodontia. No root canal work. Charges arranged by Sister in charge of clinic.

FIG. 1.—Dental work done in the outpatient department during hospital convalescence.

St. Mary's Hospital (Hayes and Stanyan Streets): Operates one unit four half days a week for adults and children. Practice limited to general dentistry. No gold work, plates, bridges or orthodontia. Volunteer work. Fee schedule.

Mount Zion Hospital Clinic (2200 Post Street): Operates one unit half time. Has one dentist on salary. Provides for prophylaxis, fillings and extractions. Has small fee schedule. Work mostly free for wards of Jewish Welfare Agency.

Homewood Terrace Hebrew Orphanage (Ashton and Faxon Avenues): Has one unit operating one-half day per week. Dentist on salary. Provides for children's dentistry only has one hygienist.

Shriners' Hospital for Crippled Children (Nineteenth and Moraga Streets): Has one unit operating one-half day a week. Volunteer dentist does minor fillings and extractions. Dental hygienist from college visits three times a week for prophylaxis. No charge for services.

San Francisco Polyclinic (1535 Jackson Street): Operates two units. Does all types of dentistry. Has three dentists working on commission basis.

Southern Pacific Hospital (Fell and Baker Streets): Has one complete dental equipment for diagnostic purposes. Does emergency extractions and dental surgery for patients in the hospital. Employs one dental intern on same basis as medical intern.

Protestant Orphanage (1801 Vincente Street): One dental unit. Part time work. General dentistry. Dentist on salary.

Laguna Honda Home (Relief Home): Has dental intern, senior dental student, who receives room and board in return for services three nights a week. Has one dental unit. Service limited to extractions and fillings.

Paraffine Paint Co. (475 Brannan Street): Has one dentist working one morning a week. Dental unit and office equipment furnished by the firm. Employes pay dentist directly. Dentist arranges charges to include cost of materials plus a small salary. All types of dental work are available.

FIG. 2.—Extracting service.

Emporium Department Store (835 Market Street): Has one dental unit, one dentist working half time. All types of dental work are available. Dentist on salary.

S. F. Nursery for Homeless Children (1350 Lake Street): Has one dental unit, one dentist working one hour each evening.

Homeopathic Clinic (185 Haight Street): Has one dental unit, three dentists working one morning each, three days a week. Volunteer service. All types of dental service for adults and children. Nominal charge for services.

Out of this group we have picked the Children's Hospital Outpatient department and Dental Dispensary as a type. Here, all kinds of service are rendered to women and children. The following paragraphs will perhaps be of some aid to those interested in establishing similar clinics in other localities.

THE DENTAL CLINIC OF THE CHILDREN'S HOSPITAL[2]

The outpatient department of the Children's Hospital was organized in January, 1918. Its purpose was to afford expert medical advice and treatment to women and children unable to pay the cost of private attention. This was made possible through the volunteer service of specialists on the hospital staff.

The medical and surgical services developed rapidly. The need for a dental department soon became evident. Equipment for one dental unit was procured but no salary was available. An invitation was sent to all women dentists in San Francisco to attend a luncheon given at the Children's Hospital, to discuss the possibility of a volunteer dental staff. The result was gratifying. Dr. F. Wagner Easton was elected chief, and five assistants volunteered to serve one half day each week.

By the end of the first year, the service became somewhat irregular. Several members were unable to continue. The department had justified its existence, but volunteer service for general dentistry had not been entirely successful. One dentist was then employed half time and a scholarship donated for the training of a dental office assistant.

The department developed gradually. More dentists were employed as the work increased. Selections were made among the young graduates of the University of California Dental College, recommended by the dean, Dr. Millberry.

In 1922, the dental staff was formally organized. The quarterly staff dinner meeting is a distinctive feature. It has created a feeling of common interest among our members and gives them an opportunity to discuss plans for present and future development. The spirit of the staff has been "Once a member—always a member."

At present, we are operating two complete dental units and a dental laboratory, and employ the equivalent of two full-time dentists. A third unit and dental roentgen-ray equipment will be considered as soon as extra space is available. Dr. John E. Gurley has been acting chief for the past four years and is responsible for all new appointments. The orthodontia service is cared for by Dr. Ernest Johnson and two assistants. Extractions and gas anesthesia are the work of Dr. Leo Schuchard, and oral surgery is done by Dr. Harold Alvarez, all being volunteer service.

The dental assistants' training course is attracting interest, especially among the recent high school graduates. This

2. By Edna J. Shirpser, R. N., Director of Social Service and Outpatient Department, Children's Hospital, San Francisco.

course covers a period of one year and consists of routine office and secretarial work, filing, suitable lectures, instructions in the medical and surgical clinics and general dental nursing. Every effort is made to obtain positions for these special students, and we are proud to state that our graduates have all been placed to mutual advantage.

Each applicant for dental care must have the recommendation of the social service department. If the income is too high, the patient is advised to consult a dentist for private treatment. Discussion of fees and collections are arranged entirely by the social service director.

The department is equipped to handle every type of dental work for hospital and outpatient department. The medical staff encourages dental examination of all patients. No child is scheduled for a tonsillectomy until all carious teeth have been filled. Dental service for children receiving hospital attention is considered a part of the medical treatment, regardless of the financial status.

It is the policy of the outpatient department to maintain the same type of service, courtesy and attention that would be given in private practice.

DENTAL SCHOOL CLINICS IN GERMANY

The Association of German Municipalities recently published in its official organ the results of an investigation into public provision for the care of the teeth of elementary school children in its member cities. The general conclusion is that the cities are giving an increasing amount of attention to this subject.

The study covered 92 cities having a population of over 50,000. Fifty of the 92 cities maintain their own dental clinics for school children. In the cities not having municipal dental clinics other arrangements are made, such as examinations and treatment provided either at the university clinic or paid for from sickness insurance funds. In many cities dentists in private practice are engaged by the authorities to give dental care.

In addition to being provided in elementary schools, dental treatment is given in an increasing number of compulsory continuation schools. At the time of the investigation mentioned above at least 28 cities were providing such treatment.

The cost of this work is met almost entirely by the municipalities. In several cities subsidies are also given by social insurance funds. A very small fee is paid by the parents in some cities.—*Zentralbl f. Jugendrecht und Jugendwohlfahrt,* Berlin, Sept. 1927, p. 157; per *Am. J. Pub. Health.*

CURRENT LITERATURE

EXTRACTS AND ABSTRACTS

Deficiency Disease in Therapeutic Diets: Three cases in which deficiency disease developed during therapeutic diets are reported by Percy B. Davidson (*J. A. M. A.,* March 31, 1928). The first patient was undergoing treatment for peptic ulcer. Pernicious vomiting following a cholecystectomy had been checked by duodenal intubation and the diet thereafter prescribed, which had a very low roughage content, with elimination of substances tending to stimulate gastric secretion. Progress was satisfactory for five weeks after intubation (eight weeks after cholecystectomy), when areas of necrosis were noted on the incisors and cuspids just above the gum margin. The condition was diagnosed by Percy R. Howe as due to a deficiency of antiscorbutic vitamins. Addition of citrous fruit to the dietary checked what appeared to be a rapidly destructive process. In a second case, the patient had been on a milk diet after gastric ulcer was diagnosed. A modified Sippy diet and later a Lenhartz diet were tried, accompanied by various pro-

cedures, transduodenal feeding, starvation and rectal feeding. The patient was unruly, had persistent vomiting and suffered much pain. It was noted that the gums were bleeding and spongy, and it was felt that this condition with the undoubted symptoms of ulcer called for radical measures, either operation or transduodenal feeding of orange juice because of its antiscorbutic qualities. Transduodenal feeding was terminated in two days at the insistence of the patient, who also refused operation, and asked for another attempt at treatment by the Sippy diet. The juice of three oranges, made neutral by the addition of sodium bicarbonate, was added. Bleeding of the gums subsided rapidly and had ceased in sixteen days. In a third case, addition of two oranges and vegetable puree to the dietary of a gastric ulcer patient on the Sippy diet brought cessation of various symptoms of malnutrition including bleeding of the gums, improvement being noted within four days. The author concludes that the necessity of adequate accessory food factors in special diets, as prophylactic against the development of a deficiency disease, and the ensuing possibly detrimental effects on the lesion under treatment, must be emphasized.

Hemorrhage in Dental Practice: The method I have found most effective whether the bleeding is from the socket or gum margin is as follows: Fold up an aseptic napkin into a pad of sufficient size to cover the bleeding socket, put this in position and ask the patient to bite on it or to hold it tightly in place with the fingers until told to let go. Then take about 6 inches of gauze tape, smear it with gum mastic solution and work on to it some finely powdered alum. Make a pad as before and on one surface put a few drops of mastic solution, and, on top of this, powdered alum. The pad which has been covering the bleeding socket is now removed and in many cases it will be found that the simple pressure has been sufficient to stop the hemorrhage. Take the gauze tape by one end in a pair of long smooth beaked tweezers which have been dipped in vaseline and insert it as far as possible up the socket, hold the gauze in position with a vaselined instrument and pack up half an inch of the gauze; continue doing this until the socket is firmly filled. The remainder of the tape is worked over the gum margins. Now apply the pad with the alum towards the gum and ask the patient to bite on it so as to maintain a firm pressure. If there is any doubt about the patient being able to do this, it is better to hold the pad in position oneself. The pressure should be maintained for fully fifteen minutes. This method I have found, if carefully carried out, almost invariably stops the hemorrhage.—R. Scott Dow, in *Brit. Dent. J.*, May 15, 1928.

Medical Perspective of Multiple Extractions: In a consideration of the medical perspective of multiple extractions and other major dental operations, Harvey Hilliard (*Dent. Surgeon*, May 26, 1928) details the care formerly given these cases, with the untoward results so common, and suggests the following points to be considered in endeavoring to assure a good prognosis in present day cases: 1. Multiple extractions should be treated as one major operation. 2. The patient should be medically examined before the operation is undertaken and this examination should include an examination of the blood. 3. The patient should be properly prepared for the operation. 4. The operation should be performed at the patient's home or a hospital so that immediately thereafter the patient can be put to bed and proper care and after-treatment can be insured. 5. A proper period of convalescence should be arranged for, and the patient should be immediately fitted with a temporary denture, so that he can partake of the diet he has found by experience best suited to him, and thus be saved from the risk of being half starved, with its inherent danger of consecutive disease.

Infrequency of Severe Rickets in New Orleans and Vicinity: 1. Severe rickets is extremely rare in New Orleans and vicinity, but a mild form of the disease prevails to the extent of about 45 per cent among children aged 3 years or less. 2. The incidence of rickets among the 100 children studied was 26 per cent. 3. The annual phosphorus level in the blood of this group of children was considerably higher than that found by Hess and Lundagen of New York. A seasonal variation in the content of inorganic prosphorus in the blood of children is verified. 4. The inorganic phosphorus content of the blood of rachitic children was always low, while the calcium levels in most of these cases were within normal limits. 5. A protective influence in green vegetables against rickets is suggested. 6. The geographic loca-

tion of New Orleans is considered the factor most responsible for the occurrence of the mild form of rickets in this locality. It is possible that good exposure to the sun of the tenement houses, the low type of buildings, playground facilities, the type of clothing and the character of the diet influence it somewhat.—C. T. Williams, in *Am. J. Dis. Child.*, April, 1928.

Diathermy Operations for Carcinoma of Tongue: The results that have been reported from the use of diathermy in the treatment of cancer of the tongue, Harmer *(Brit. J. Surg.)* says, are so encouraging that there can be no doubt that it is one of the best methods of treatment that has so far been devised. If the operation is properly carried out by the bloodless method, there is no danger of disseminating the growth. Certainly it is easier to operate by this means than with the knife. The treatment can be carried out in a shorter time, and there need not be any handling of the tissues. Complications are also less frequent than after cutting. Thus, there is less shock and toxemia. The absence of pain is remarkable, and allows of easier swallowing. The sloughing that results is harmless. Many cases which would be considered inoperable by ordinary means can be relieved, if not cured, by the method—in fact, it may be the only means of sterilizing a painful septic sore. Even if life is not prolonged, the existence of the patient may be rendered more bearable.—*J. A. M. A.*, July 7, 1928.

Use and Abuse of Radium: It is dangerous to treat cancer of the lip with radium unless some notice is taken of the glands. This is true of any metastasizing tumor. Probably twenty times a year, I see people returning one to five years after treatment of cancer of the lip with radium with inoperable glandular metastases. Surgical removal of the lip lesion with the glands draining the region is the method of choice. In the treatment of cancer of the tongue and buccal mucosa, surgery is first, surgery and radium second and radium alone third in order of efficiency. —Ernest M. Daland, in *New England J. Med.*, June 28, 1928.

The Cost of Medical Care: The aim of the Committee on the Cost of Medical Care is to try to develop a program which will be based on the three following groups of studies: 1. Preliminary survey of data showing incidence of diseases and disabilities requiring medical service and of the existing facilities for dealing with them. 2. Studies on the cost to the family of medical services and the return accruing to the physician and other agents furnishing such service. 3. Analysis of specially organized facilities for medical care now serving particular groups of the population. There is considerable material available on all these points, but it has not been properly digested and coordinated. The following subjects have been given a priority: 1. The diseases and conditions most responsible for disability and inefficiency. 4. Existing facilities for the treatment and prevention of disease and defectiveness,—statistical study. 5. Surveys of the medical services of a large city, of a small city, of a rural community. 6. The cost of sickness, during a twelve months period, among various representative population groups, including the incidence of sickness. 9. Capital investment and income in private practice. 10. Capital investment in hospitals and clinics. 11. Organized medical service in industry and in universities. 12. Pay clinics and group clinics.—Ray Lyman Wilbur, in *California and West Med.*, July, 1928.

Extension of Surgery of Neoplastic Diseases by Endothermy: It is in the field of mouth carcinoma that endothermy finds its greatest usefulness. Danger of mechanical transplantation is minimized, hemorrhage and surgical shock are eliminated and there is an immediate sterilizing effect of intense heat upon the foul, painful area which permits the early return to normal diet. In all cases of cancer of the oral cavity, we realize that the great problem lies in the neck. In the brief space allotted this paper there can be no discussion of detailed treatment. We would say only that our experience has led us to share the view of Mr. Clayton-Greene and his English confrères. Mr. Clayton-Greene says: "I am becoming more and more doubtful as to the value of big gland dissections practised in cases of carcinoma of the tongue. If the glands are not involved the operation is unnecessary, and if they are extensively affected, it does not seem to prevent recurrence." To the surgeon whose teaching has included the removal of all glands of the neck in treating cancer of the mouth and who is unwilling to change the fixed routine of the operation, we suggest only that in the endotherm knife there is provided a means by which this dissection

may be done without opening lymphatics.—George A. Wyeth, in *Am. J. Surg.*, April, 1928.

Radium and Radon in Treatment of Epithelioma of Lip: Simpson and Flesher (*Illinois M. J.*, July, 1928) report the treatment of seventy-four cases of primary epithelioma of the lower lip with radon (radium emanation), 1920-1924. Since 1919, radium has been replaced entirely by radon in their treatment of cases of carcinoma. In the group reported, the ages ranged from 34 to 76. There were sixty-eight men and six women. The duration of the lesions varied from two months to two years. In twelve patients, enlarged lymph nodes regarded as carcinomatous were present. In sixty-two, no lymph nodes were found. Six cases were considered inoperable. Fifty-seven cases have been followed up. Forty-seven patients have been clinically well for from three and one-half to seven years, an average of four years and eight months. Three had palpable lymph nodes at the time of treatment. Ten of the fifty-seven patients have died. The duration of life in those who died after treatment was started varied from six to fourteen months, the average duration being nine months. None of the ten patients who died had palpable lymph nodes when treatment was begun. The last Radium Report of the Memorial Hospital, New York City, states that the primary lesion in epithelioma of the lip should be managed entirely by the use of radium. The authors subscribe to this opinion provided a sufficient quantity of radon, i. e., from 500 to 1,000 more millicuries, is available. The glands of the neck, whether palpable or not, should practically always be irradiated. If only one submaxillary gland is involved, it may be excised. If other groups of lymph nodes are affected, irradiation is preferable to operation.

Difficulties of Bronschoscopy: In enumerating the difficulties of bronschoscopy, G. W. Boots (*Illinois M. J.*, July, 1928) first emphasizes the importance of having all instruments in good working order. The tube must not be forcibly passed through the larynx. It must not be passed until the operator has a direct vision of the structures beyond. Bronschoscopy is a very dangerous procedure if the patient has high blood pressure, decompensated heart or signs of impending apoplexy. Dyspnea may be increased by muscular relaxation resulting from administration of the anesthetic. The patient must be properly prepared for this, the most difficult field in medicine or surgery, in the author's opinion. Attempts at bronschoscopy or esophagoscopy are contraindicated in the presence of retropharyngeal abscess. Local anesthesia with cocain holds the danger that, because of the ready absorption of the drug by the fauces, pharynx or esophagus, the patient may be in convulsions before it is evident that he is anesthetized. A tracheotomy set, a suction apparatus and a "locktite" mouth gag should be in readiness for emergencies. There is always the danger that a tooth may be broken off. The size and location of the foreign body should always be determined before starting the operation. The tube must be as small as is practicable. Because of the danger of edema of the glottis, small children should be kept in the hospital and under observation for a day or two after removal of the foreign body.

Factors Reducing Mortality in Nitrous Oxide-Oxygen Anesthesia: 1. More attention should be given to the preoperative treatment of the patient. Measures used following operations should often be employed before the operation, and this applies particularly to transfusion. 2. The factor of psychic shock is more often the one that turns the scale than is generally supposed. 3. If an inhalation anesthetic is used, gas should be the choice. Its sole danger is in the interference with oxidation. Since death from nitrous oxide is caused by asphyxiation, I believe that nitrous oxide is not dangerous if the patient's color is kept good. This is best observed by noting the condition of the blood. The surgeon and his assistants become accustomed to observing the blood and to noticing immediately the slightest change from a bright scarlet hue. It is only necessary for the surgeon to say "a little dark" for the anesthetist to bring back instantly the bright color. There is no other anesthetic which has such a clear, definite, warning signal. Nothing can be wrong with a patient who has a good color. If this fact is observed and if the heart is watched while anesthesia is induced, there is no danger. 4. The heart will sometimes dilate while the patient is going under the anesthetic. This may account for some fatalities, both on the operating table and following operation.—G. A. Haveman, in *J. A. M. A.*, May 26, 1928.

Cancer Control in Massachusetts: In the records are many facts which may be instrumental in determining our future policies. Thirty-one per cent of the clinic attendance has been men and 69 per cent women, and 23.1 per cent were found to have cancer. Of the group having cancer, 68.8 per cent were reported to be in the operable stage. The median age of the noncancerous individuals who attended the clinics was 46 years, while that of the cancer patient was 60 years. Of those coming to the clinics, 61.6 per cent came because of newspaper publicity, 20.1 per cent at the advice of a physician, and 18.3 per cent for other reasons.—G. H. Bigelow and Herbert L. Lombard, in *Am. J. Pub. Health,* April, 1928.

Surgical Treatment of Trigeminal Neuralgia: Differential section is a further refinement in the surgical treatment of trigeminal neuralgia which has proved a satisfactory procedure in Stookey's experience (*Ann. Surg.,* February, 1928). By differential section is meant section of the fibers within the dorsal root central to the ganglion derived from the division producing the pain without section of the remaining fibers. If the pain is in the mandibular division, the mandibular fibers central to the ganglion are cut without cutting the mandibular or ophthalmic fibers. If the pain is in the maxillary division, these fibers are cut without injury to the mandibular or ophthalmic fibers. If the pain is in the ophthalmic division alone, without involvement of the maxillary or mandibular areas, the ophthalmic fibers are cut. In differential section, only those fibers along which the pain impulses are carried are cut. Thus, both the anesthetic area and the attendant paresthesias are reduced to a minimum.—Abstr. *J. A. M. A.*

MISCELLANY

BOOK REVIEWS

Diseases of the Soft Structures of the Teeth and Their Treatment. A Text Book for Students and Practitioners. By Herman Prinz, A.M., D.D.S., M.D., D.Sc., Professor of Materia Medica and Therapeutics, The Thomas W. Evans Museum and Dental Institute, School of Dentistry, University of Pennsylvania, Philadelphia. 293 engravings, 496 pages. Published by Lea & Febiger, Philadelphia.

The author of this book is so well known as a dental writer that his name will at once command respect. His method of handling the various topics is illustrated by the outline he gives of dental diseases. It is as follows:

Name of the disease and its symptoms; definition of the disease; etiology of the disease; clinical pathology of the disease; symptoms of the disease; complications and sequels of the disease; diagnosis of the disease; prognosis of the disease; treatment of the disease.

A great deal of attention has been given to diseases of the dental pulp, and apparently every possible manifestation of disturbance of the pulp has been considered.

That the author is not in complete despair over the problem of filling root canals is shown by the fact that he has devoted eleven pages to a consideration of this operation.

Naturally much attention is given to the subject of pyorrhea alveolaris, an entire section of the book being devoted to this disease.

The volume as a whole must be recorded as a distinct addition to the literature of the profession and the author and publisher are to be commended and congratulated.

Outlines of Dental Science. Dental Anatomy. By David Headridge, L.D.S., R.C.S. (Eng.), Lecturer in Dental Anatomy and Histology, University, Manchester, and S. Knight Gibson, L.D.S. (Man.), Demonstrator in Dental Histology, University, Manchester; 243 pages.

Dental Metallurgy. By A. Johnstone Brown, L. R. C. P. & S., L. D. S. (Edin.), Lecturer on Dental Metallurgy, Demonstrator on Dental Radiology, Stopping-Room Tutor, Edinburgh Dental Hospital and School, Dental Surgeon, Rangour Mental Hospital and Longmore Hospital for Incurables, Examiner for the Final Dental Exam-

ination, Royal College of Surgeons, Edinburgh. 190 pages; illustrated. Published by William Wood and Company, 51 Fifth Avenue, New York.

These are respectively Vols. VI and XI of the Outlines of Science Series, and are sold at $2.50 each. For handy reference to the essentials of the subjects treated, they are admirable, and they will be found of service to students in reviewing the subjects, as well as to practitioners for daily consultation in the routine of work.

Simplification of Dental Hypodermic Needles Considered

The Division of Simplified Practice of the Bureau of Standards, United States Department of Commerce, has been requested by the American Dental Trade Association to consider a project for the simplification of dental hypodermic needles.

A meeting of manufacturers and distributors of needles was held June 27 at Niagara Falls, Ontario, at the request of Mr. John M. Clauser, chairman of the Simplification Committee of the American Dental Trade Association to consider the matter. Mr. George Schuster attended this conference as the official representative of the Division of Simplified Practice, and explained the cooperative services which the Department of Commerce is prepared to offer industry in the development of simplification programs.

A survey of the existing variety of needles was presented by Mr. C. J. Pilling, chairman of the Instrument Section of the Manufacturers' Division of the American Dental Trade Association. This survey disclosed the fact that there is a need for simplification and reduction in variety of needles.

The conference requested Mr. Pilling to draft a tentative simplified list of sizes which will be used as the basis for a simplified practice recommendation covering dental hypodermic needles. This tentative list will subsequently be submitted to a general conference of manufacturers, distributors, and users, assembled under the auspices of the Division of Simplified Practice.—From the Department of Commerce, Bureau of Standards.

NEWS

Charter Member of Dental Society Honored: R. H. Jones, of Winston-Salem, N. C., the only surviving charter member of the North Carolina Dental Society, organized in 1875, and of which he is a past president, had a page in the society proceedings of 1927 dedicated to him as a mark of appreciation of his long service in the association. Dr. Jones, who is 80 years of age and who has been in active practice for fifty-three years, recently enrolled for the ten weeks' postgraduate course in dentistry offered by the University Extension Division.

Dr. Burke at Veterans Hospital: John J. Burke of St. Louis, Mo., has been appointed as dental surgeon at the Veterans' Bureau Hospital, Battle Creek, Mich. Dr. Burke was formerly at Jefferson Barracks, St. Louis.

Colorado State Society Elects Officers: The following were elected as officers of the Colorado State Dental Association at the annual meeting in June. President, Earl H. Zimmer, Colorado Springs; president elect, H. B. Talhelm, Denver; vice president, I. R. Bertram, Denver.

Utah State Association Officers: The following have been elected as officers of the Utah State Dental Association for the ensuing year: President, R. C. Dalgleish; president elect, Hyrum Bergstrom; secretary-treasurer, T. Fred Hardy; all of Salt Lake City.

Dr. Ishiwara Retires: Prof. Dr. Ishiwara, who has been the professor of dentistry in the Medical Department of the Tokyo Imperial University for the last twenty years, has retired.—*J. A. M. A.*, July 28, 1928.

Australian Dental Association Formed: At a meeting of the dentists of Australia at Canberra, the Australian Dental Association was formed. W. R. Parker of Brisbane was made president. The triennial congress will hereafter be known as the Congress of the Australian Dental Association.

DEATHS

Browne, Frank L., Chicago, Ill.; died, July 12; aged 75. Dr. Browne formerly lived in Danville, Ill. He had been ill since last September, when he suffered an injury in getting on a motor bus.

Green, John J., New York City; University of Michigan, College of Dental Surgery, 1890; died, July 5. Dr. Green formerly lived in Ionia, Mich.

Grove, Edward P., Utica, N. Y.; Temple University School of Dentistry, 1897; died June 22, after a three weeks' illness.

Hamil, Hugh F., Bainbridge, Ga.; Vanderbilt University School of Dentistry, 1899; died, June 29; aged 52.

Matthews, Rudolph, Wichita, Kan.; Washington University School of Dentistry, 1870; died, July 7; aged 83. Dr. Matthews was the oldest practitioner in Kansas and a veteran of the Civil War. He was well known as a naturalist and geologist.

Sheetz, N. I., Neponset, Ill.; died of heart disease of many years' standing, June 23; aged 73. Dr. Sheetz practiced in Galva, Ill., for forty-three years. He retired in 1921.

Smith, J. D., Jacksonville, Ill.; Vanderbilt University School of Dentistry, 1893; died, July 10; aged 58. Dr. Smith was the dentist at the Jacksonville State Hospital.

Phillips, Dean R., Chicago, Ill.; died, July 18, of heart failure; aged 65.

ANNOUNCEMENTS

CALENDAR OF MEETINGS*

STATE SOCIETIES

District of Columbia, at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June inclusive.

September (1928)

Maryland, at Annapolis (10-11).

December (1928)

Ohio, at Toledo (4-6).

May (1929)

West Virginia, at White Sulphur Springs (20-22).

Chicago Dental Society Midwinter Clinic, Jan. 14-16, 1929.

First District Dental Society of the State of New York, Dec. 3-6, 1928.

MEETINGS OF STATE BOARDS OF DENTAL EXAMINERS

New Jersey, at Trenton, Dec. 3-8, 1928. Secretary, John C. Forsyth, 148 West State St., Trenton.

FIRST DISTRICT DENTAL SOCIETY STATE OF NEW YORK

The Fourth Annual Meeting for Better Dentistry of the First District Dental Society will be held at the Hotel Pennsylvania, New York City, Dec. 3-6, 1928.

The committee has added a full day to the meeting this year; therefore, there will be five clinic sessions, three general lecture sessions and one session devoted to lectures of the four Sections of the First District Dental Society.

The same plan of subscription will be continued; namely, $5.00 admits a member to all sessions.

Among our essayists and clinicians will be C. N. Johnson of Chicago, Robert R. Gillis of Hammond, Ind., Robert H. Ivy of Philadelphia, Pa., Benjamin Tischler, Boston, Mass., Raymond A. Albray, Newark, N. J., John G. Logan, Portage, Pa., and Percy R. Howe, Boston, Mass.

There will be a manufacturers exhibit under the auspices of the Manufacturers Club of the American Dental Trade Association and Independent Dental Manufacturers Association in the hotel during the meeting.

Address all communications relative to subscriptions, clinics, etc., to E. M. Davies, 2 East 103rd Street, New York City.

JOHN T. HANKS, *Chairman.*

THE STATE BOARD OF REGISTRATION AND EXAMINATION IN DENTISTRY OF NEW JERSEY

The State Board of Registration and Examination in Dentistry of New Jersey will hold its regular examinations at Trenton, commencing Dec. 3, 1928, and continuing for five days thereafter.

The examination fee is $25.00; reexamination fee, $10.00.

Practical tests required: Insertion of an approximal gold filling, with the approximating tooth in position, compound approxi-

*Announcements must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

mal amalgam filling and a silicate filling, the candidate to furnish his own patient; taking of impression, bite, selection of teeth, articulation and trial denture, the candidate to furnish his own patient; practical examination in mouth diagnosis.

Attention is invited to the following quotation from the dental law of New Jersey: "Applicant shall present to said Board a certificate from the Commissioner of Education of this State, showing that before entering a dental college, he or she had obtained an academic education, consisting of a four-year course of study in an approved high school, or the equivalent thereof."

In accordance with this law, the secretary will issue application blanks only on presentation of the required certificate from the Commissioner of Education, State House, Trenton, N. J.

Application must be filed, complete, ten days before the date of the examinations (Nov. 23, 1928).

Address all communications for further particulars to

JOHN C. FORSYTH, *Secretary,*
148 West State Street, Trenton.

THE HYATT STUDY CLUB

In the fall of 1927, at the instigation of Thaddeus P. Hyatt, a group of men met to consider the possibility of evolving an operative procedure for the prevention of caries. The regular monthly sessions were productive of much interesting discussion and certain more or less established data were formulated as a working basis.

(A) That enamel is the hardest tissue in the human body, composed for the most part of inorganic substance and that its chief function is to serve as a protective covering for the more vital tissues of dentin and pulp against bacterial, mechanical, chemical and thermal irritants.

(B) That the enamel is completely formed prior to the eruption of the tooth; the enamel producing cells, the ameloblasts, becoming completely atrophied, and for that reason the enamel, unlike the dentin, does not possess the very important property of repair.

(C) That constitutional conditions will influence changes in the dental tissues, and particularly nutritional deficiencies and parathyroidal dysfunction, in that the bodily reserve of calcium salts may become diminished and may thereby diminish the calcium content of the dental tissues, lowering their general tone and perhaps making them more prone to bacterial invasion.

(D) That the smallest opening in the enamel is conducive to a bacterial colonization and invasion.

(E) That pits and fissures are natural defects, evidences of improper coalescence of the primary parts.

(F) That according to the statistical evidence of an examination of about 19,000 mouths at the Metropolitan Life Insurance Company under the direction of Dr. Thaddeus P. Hyatt, by far the largest number of carious cavities have their origin in pits and fissures and for that reason the adjective "pre-carious" was prefixed to pits and fissures by the unanimous consent of the Hyatt Study Club.

(G) That caries appears to progress much more rapidly in dentin than in enamel, and therein lies the greatest danger of pre-carious pits and fissures, in that the dentin may be appreciably destroyed before there is any marked destruction of the enamel at the point of entrance.

(H) That to establish an operative procedure that would eliminate pre-carious pits and fissures would prove to be a definite step in the direction of preventing a large proportion of carious cavities.

Prompted by the foregoing data, the following plan of investigation was adopted:

1. To standardize the terminology to be employed in connection with prophylactic odontotomy.

2. To evolve a comprehensive diagnostic procedure for the detection of pre-carious pits and fissures and to determine the age at which the operative procedure should be instituted.

3. To evolve an operative procedure that will necessitate the removal of the least amount of tooth substance and yet, at the same time, secure the maximum amount of protection for the dentin and pulp.

4. To standardize the instrumentarium.

5. To standardize the filling material.

Three subcommittees were appointed to carry on these investigations. The Hyatt Study Club believes it is desirable to secure the cooperation of all members of the dental profession throughout the world who are interested in the possibilities of prophylactic

odontotomy and therefore cordially invites them to correspond with us.

All letters to be addressed to the secretary, Joseph H. Kauffman, 110 East 54th Street, New York City.

LeRoy L. Hartman,
Maurice William,
M. Diamond, *Chairman,*
Publication Committee.

ALAMEDA COUNTY DISTRICT DENTAL SOCIETY

The Alameda County (California) District Dental Society has completed plans for holding a convention in the form of "a practical demonstration of practical dentistry" at the Hotel Leamington, in Oakland, October 4-6. About forty-five dentists will give clinics, among whom are R. H. Volland, of Iowa, President of the American Dental Association; Richard H. Reithmuller, Frank Kaiser, Carl D. Lucas, Donald Smith, Harry R. Potter and others. Moving pictures will be shown by Hugh Avery on "The Preparation of the Tooth for and in Making of Porcelain Jacket Crowns," while Sanford Moose will show several reels on "Gas Anaesthesia" and the operations for cysts and cleft palate. There will be a banquet on the evening of October 4, when the Hon. John L. McNab, who nominated Herbert Hoover for President of the United States, will be the principal speaker.

All ethical dentists, whether members of a dental society or not, are cordially invited and urged to attend this unusual convention. The presentation of your business card is your only admission fee.

S. Winston Harrison,
Publicity Chairman.

ST. LOUIS CLUB OF DENTISTRY

The St. Louis Study Club of Dentistry, organized in 1919 for the purpose of teaching advanced dental subjects to ethical dentists, without charge, will open its eleventh annual semester on Wednesday, Oct. 3, 1928. The sessions will be held from 8 to 10 p. m. All classes are to be given at the St. Louis University College of Dentistry.

The following classes will be covered during this term:

Dental roentgenology
Dental ceramics
Fixed bridgework
Full dentures
Conduction and local anesthesia
Rizadontia
Operative dentistry
Dental economics
Clinical dental prophylaxis
Anatomy and dissection of the head
Oral diagnosis and diseases of the mouth

Bulletins, giving detailed information regarding the study club and its courses, may be had by addressing A. C. Mogler, *Secretary-Registrar,* 4360 Warne Avenue, St. Louis, Mo.